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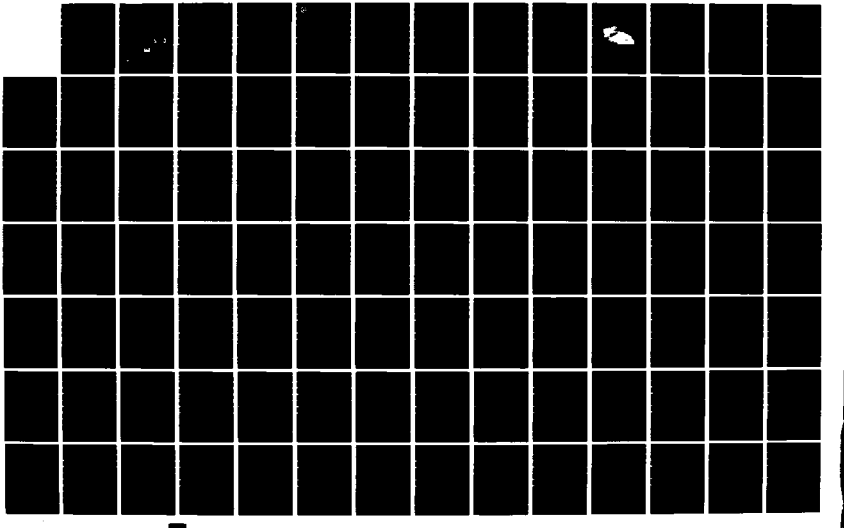

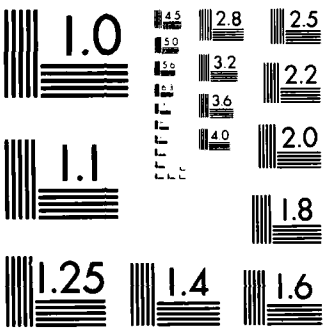

ANDROSCOGGIN RIVER BASIN

BERLIN, NEW HAMPSHIRE

SITE NO.1, DEAD RIVER DAM
N H 00473

STATE NO 24.14

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1979

UNCLASSIFIED

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Androscoggin River Basin
Berlin, New Hampshire
Jericho Brook

20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam has a hydraulic height of 46.5 ft and is 3035 ft. long. The dam is good condition with a few minor concerns which need attention. It is intermediate in size with a high hazard potential. A major breach at normal or recreation pool level could result in the loss of 10 or more lives and excessive property damage.

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424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

JAN 16 1980

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Site No. 1, Dead River Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, City of Berlin, Berlin, New Hampshire 03570.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH00473
Name of Dam:	Site No. 1, Dead River
City:	Berlin
County and State:	Coos County, New Hampshire
Stream:	Jericho Brook
Date of Inspection:	June 7, 1979

BRIEF ASSESSMENT

Site No. 1, Dead River Dam (the Project) has a hydraulic height of 46.5 feet, is 16 feet wide at its crest, and is 3,035 feet long. It is a zoned compacted earth embankment with a 100-foot wide grass covered earthen emergency spillway. The dam spans a reach of Jericho Brook, and is located in northeastern New Hampshire approximately 4 miles northwest to the City of Berlin. Maximum storage capacity is about 4,720 acre-feet. The Project is a dual-purpose structure, providing recreation and flood control. The pond (Jericho Lake) is approximately 3,700 feet in length with a normal surface area of about 132 acres.

The dam is in good condition. Minor concerns are: extensive vehicular trespassing on the crest, the upstream slope, the downstream slope, and the area immediately downstream of the toe of the dam is destroying the grassy ground cover and leaving ruts in the ground surface. Two minor seepages near the outlet of the principal spillway discharge pipe and the two corrugated metal underdrain pipes; and one seepage approximately 300 feet south of the bend in the dam and 100 feet downstream from the toe of the dam.

Based on an intermediate size and a high hazard classification in accordance with Corps guidelines, the test flood is the Probable Maximum Flood (PMF). A test flood inflow of 16,870 cfs was routed, resulting in a test flood outflow of 7,975 cfs (1,231 csm) would not overtop the dam although the reservoir would rise to elevation 1,370.9 feet MSL, which is 0.1 feet below the top of the dam. The spillway will pass 8,102 cfs or about 102 percent of the test flood. A major breach at normal or recreation pool level could result in the loss of 10 or more lives and excessive property damage.

The owner, City of Berlin, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within 2 years after receipt of this Phase I Inspection Report.

Warren A. Guinan
Project Manager
N.H. P.E. 2339

This Phase I Inspection Report on Site No. 1, Dead River Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

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APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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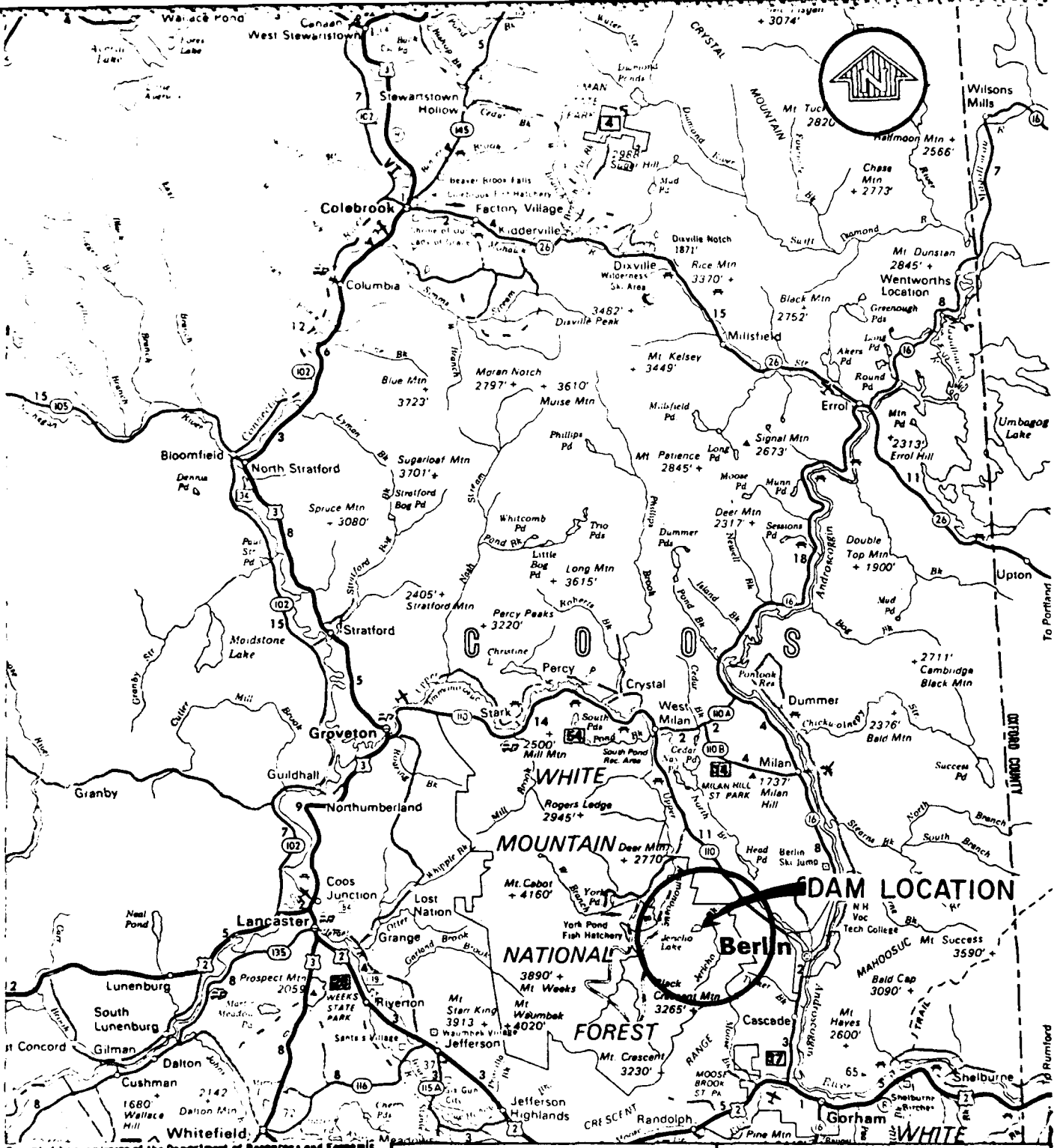
APPENDICES

Figure 1 - Overview of Site No. 1, Dead River Dam.



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SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW HAMPSHIRE OFFICIAL HIGHWAY MAP.

Anderson-Nichols & Co, Inc.	U.S. ARMY ENGINEER DIV. NEW ENGLAND
CONCORD NEW HAMPSHIRE	CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SITE NO.1 DEAD RIVER DAM LOCATION MAP

DEAD RIVER NEW HAMPSHIRE

			SCALE: SEE BAR SCALE
			DATE: JULY 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
SITE NO. 1, DEAD RIVER DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of March 22, 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0050 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Site No. 1, Dead River Dam, (the Project) is the primary structure in the Soil Conservation Service Dead River Watershed project and is located in the City of Berlin, Coos County, New Hampshire. The project consists of a multiple-purpose dam and an earthen dike. The dike is located on the watershed divide approximately 4,150 feet to the northwest of the dam. The dam, constructed for flood protection and recreation, spans Jericho Brook and creates Jericho Lake. After discharging through the dam, Jericho Brook flows easterly for a distance of approximately 1.75 miles before turning sharply to the southeast. Here, approximately 0.25 miles downstream of its crossing by Route 110, Jericho Brook becomes known as the Dead River, although both names refer to the same watercourse. The Dead River continues to the southeast approximately 3.0 miles to its confluence with the Androscoggin River; for the last 0.5 miles of its course, the Dead River flows through an urbanized area of

Berlin, including the Central Business District. The dam is located on the U.S.G.S. Quadrangle, Mt. Washington, N.H. with coordinates at N 44° 29' 47", W 71° 15' 18". (See Location Map, page vii.)

b. Description of the Dam and Appurtenances. The Project consists of an earthen dam and an earthen dike. The latter is located approximately 4,150 feet to the northwest of the dam. The dam, the primary structure at Site No. 1 is oriented in a north-south direction and has a 60° 30' bend to the southeast located 525 feet south along the dam from the principal outlet structure. The dam, about 3,035 feet long, 46.5 feet high (hydraulic height) and 16 feet wide at its crest consists of: a 2,935-foot long earthen dam embankment, a 100-foot wide grass-covered emergency spillway, which is located between the north end of the dam and the north abutment, a 3.5' x 10.5' two-stage drop-inlet riser, discharging into a 42-inch diameter reinforced concrete conduit extending through the dam and a 30-inch diameter low-level reservoir drain pipe extending into the pond (Jericho Lake) behind the dam.

The dam is a zoned and compacted earthen structure with a cutoff through alluvium, glacial till, and decomposed rock to firm bedrock. The upstream slope of the embankment is inclined at 3H:1V and downstream face has a 2.5H:1V slope. Design plans indicate that two 12-inch diameter perforated corrugated metal pipes are located near the downstream toe of the dam to collect seepage. These pipes drain into the downstream outlet channel in the vicinity of the principal spillway discharge pipe.

The two-stage riser is the principal outlet structure or spillway, consisting of two 2'H x 2.7' W inlets at the lower level and two 1.9'H x 10.5'W inlets at the second level discharging into a 3.5' x 10.5' shaft connected to a 42-inch diameter reinforced concrete pipe. Trash racks prevent debris from entering the inlets causing blockage of the riser shaft or the 42-inch reinforced concrete discharge conduit. The low-level 30-inch reservoir drain pipe from the upstream reservoir pool is connected to the riser shaft at the invert of the 42-inch diameter reinforced concrete conduit, which discharges into a riprapped plunge pool at the downstream toe of the dam. Invert data on all outlets is provided in Section 1.3. The reservoir drain is sealed by a regular sluice-type gate (cast iron disk) which is controlled by a geared hand-crank gate lift mechanism located on the concrete platform on top of the riser. A manhole located on the platform nearby permits entrance into the structure for servicing the principal outlet works and the reservoir drain gate lift mechanism.

The dike is a zoned earthen structure with a cutoff along the centerline of the structure through alluvium, glacial till, and decomposed rock to firm bedrock. The dike embankment is approximately 1,665 feet long, 14 feet high (structural and hydraulic height), 10 feet wide at its crest, and the upstream and downstream slopes are inclined at 3H:1V. Its crest elevation is equal to that of the main dam embankment.

Breach of the dam at normal pool would result in a flood stage of 20.0 feet, 7.0 feet over the roadway, at the Route 110 bridge, 1.4 miles downstream of the dam. It was determined that the breach would result in a stage of about 13.2 feet at the Converse Building (currently closed) on the north side of Route 110, 0.4 miles southeast of the Route 110 crossing of Jericho Brook and approximately 1,8 miles downstream of the dam. At this stage, the Converse Building would be inundated by 3 to 5 feet of water causing extensive property damage. However, the reach further downstream where the Dead River flows through a heavily urbanized area of the City of Berlin, is a far greater hazard area. Previous floods in 1927, 1936, and 1953 caused great property damage in this area. An estimated 70 residential and commercial structures in this area are subject to flood damage. The SCS manuscript Work Plan for Watershed Protection, Flood Prevention, and Recreation, Dead River Watershed (June 1965) discusses at length the Dead River major flooding events. The most devastating flood (1936), with a discharge estimated to have been 2,000 cfs, has a return period (recurrence interval) of approximately 100 years. It was determined that breach of the dam, generating a discharge of approximately 18,200 cfs, would result in a stage of about 21.1 feet at the Main Street bridge which could cause excessive damages and considerable loss of life (10 or more) in the most heavily urbanized area of Berlin. This downstream hazard reach begins approximately 4.0 miles downstream of the dam and 0.75 miles above the confluence of the Dead River with the Androscoggin River.

Breach of the dam at emergency spillway elevation would result in a flood stage of 21.5 feet, about 8.5 feet over the roadway at the Route 114 bridge. The resulting stage at the Converse Building downstream of the bridge was determined to be 17.0 feet, causing a 7 foot inundation of the building. At the Main Street bridge, the breach discharge of 31,700 cfs would result in a stage of about 23 feet.

As a result of this analysis and due to major historical flooding events on the Dead River in the City of Berlin, the dam is considered to be of High Hazard potential. For more detailed information regarding the breach analysis and the SCS Watershed Work Plan see Appendix D.

e. Test Flood Analysis. The dam is classified as being intermediate in size, having a hydraulic height of 46.5 feet and a maximum (top of dam) storage of approximately 4,720 acre-feet. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood was determined to be the Probable Maximum Flood (PMF). The watershed above the dam, determined by the SCS to have an average slope of 685 feet/mile, is classified as being mountainous. From the PMF Peak Flow Rates graph the discharge for a mountainous watershed of 6.48 square miles is 2,130 cubic feet per second per square mile (csm) of drainage area. Thus, the peak inflow into the site is 13,800 cubic feet per second (cfs). However, SCS developed a freeboard hydrograph which generated a higher peak inflow (16,870 cfs or 2,600 csm) which has been considered to be the PMF because of the greater detail employed in the SCS analysis. An outflow of 7,975 cfs or 1,230 csm was determined by theSCS from a routing and has been employed as the test flood. Analysis of the elevation versus discharge curves indicates that the principal and emergency spillways combined are capable of passing the test flood without dam overtopping. A discharge of the test flood magnitude would result in a reservoir pool elevation of 1,370.9 feet MSL, which is 0.1 feet below the top of the dam. The total project capacity is 8,102 cfs which is 102 percent of the test flood discharge.

f. Dam Failure Analysis. The impact of the failure of the dam with the reservoir at recreation or normal pool elevation (principal spillway crest) was assessed using the Guidance for Estimating Downstream Dam FAilure Hydrographs issued by the Corps of Engineers. Owing to the capacity of the dam project, it was assumed that assessing the impact of dam failure at top of dam (elevation 1,371.0 feet MSL) would be an unrealistic analysis. Therefore the dam failure analysis with Jericho Lake at normal pool level (1,352.0 feet MSL) and at the crest of the emergency spillway (1,362.0 feet MSL) was assessed. Though analysis of dam failure at normal flow conditions was sufficient to identify the hazard potential, computations for failure at emergency spillway crest were also completed.

It was also unrealistic to assume that the dam's breach width would be 640 feet (0.4 times the dam's length at mid-height) as is suggested in the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs. A breach width of 100 feet has been assumed to be a more realistic value. The analysis covered the downstream reach extending from the dam to the urbanized area of the City of Berlin, approximately 4.0 miles below on the Dead River. Although the dam spans Jericho Brook and creates Jericho Lake, it has been determined from field inspection that the Dead River and Jericho Brook are the same watercourse. Approximately 1.75 miles east of the dam, Jericho Brook turns sharply to the southeast and is renamed the Dead River. The watercourse is known as the Dead River from this point to its confluence with the Androscoggin River 3.0 miles downstream.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. The Project consists of an intermediate height earthen dam and an earthen dike which impounds a reservoir (Jericho Lake) of intermediate size. The total length of the dam embankment is 3,035 feet which includes 100 feet of grass-covered earthen emergency spillway. The top of the dam (1,371.0 feet MSL) is 9.0 feet above the emergency spillway crest and 19.0 feet above the low-stage of the principal spillway. The dike, approximately 4,150 feet west of the dam, on the watershed divide, is an earthen structure 1,665 feet long with a crest elevation of 1,371.0 feet MSL. The normally maintained recreation pool (1,352.0 feet MSL) extends approximately 3,700 feet upstream of the dam; the flood control pool (1,362.0 feet MSL) extends approximately 4,150 feet upstream of the dam to the dike embankment.

SCS has calculated the time required to draw down Jericho Lake, first, from the flood-control pool elevation to the principal spillway crest and, secondly, from the principal spillway crest to the level of the reservoir drain (see Appendix B). A drawdown estimate was calculated assuming no inflow, the two-stage riser was the only discharging outlet, and reservoir pool level initially at the crest of the emergency spillway (1,362.0 feet MSL). An analysis of the drawdown capacity under falling-head conditions determined that it would take 10.1 days to draw down the lake to the level of the principal spillway crest (1,352.0 feet MSL). The second drawdown estimate was calculated assuming an average inflow rate of 10.5 cfs (1.62 csm) into the reservoir, the 30-inch diameter reinforced concrete low-level reservoir drain pipe was open and flowing full, and the reservoir pool level was initially at the crest of the principal spillway. It was determined that it would take 10.8 days to drain Jericho Lake under these condition.

b. Design Data. Detailed hydrologic and hydraulic data for the Project were disclosed (Appendix B). SCS design details give a principal spillway capacity of 302 cfs and an emergency spillway capacity of 7,800 cfs. The as-built plans indicate that the design capacities are representative of as-built conditions.

c. Experience Data. The owner of the dam has indicated that the maximum stage at the damsite occurred when the reservoir pool elevation reached the second-stage outlet of the principal spillway. Flow was estimated to have been 90 cfs.

d. Visual Observation. No evidence of damage to the dam as the result of flood flow was visible at the time of this inspection. The reservoir pool has never reached the dike embankment.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

Formal operating procedures (see Appendix B, pages B-1 to B-5) have been agreed upon by the Soil Conservation Service, the designer of the Project, and the City of Berlin, the current owner and sponsor of the project. The City is required to inspect all structural works of improvement annually and after every major storm or occurrence of any unusual adverse conditions that affect their operation. However, the only operable outlet structure at the Project, is the 30" low-level reservoir control which allows the pool to be drawn down for cleaning or repairs at the site. The principal and emergency spillways function automatically as the reservoir pool elevation changes. The SCS provides consultative assistance to the City of Berlin for the operation of the structures.

4.2 Maintenance of the Structures

The City of Berlin has been responsible for the maintenance of Site No. 1, Dead River Dam since 1973. As set forth in the Operation and Maintenance Agreement between the City and the SCS, the City must obtain SCS approval of all plans, designs, and specifications for maintenance work involving major repairs "... which include: (1) repairing separated joints, cracks, or breaks in the principal spillway, (2) correcting seepage, (3) replacing significant backfill around structures resulting from major erosion damage, (4) major vegetation due to failure to obtain an adequate vegetative cover, and (5) restoring areas with significant erosion caused by unusual flow in emergency spillways." The City is required to undertake all maintenance that the SCS has determined to be necessary. The SCS will provide the City with consultative assistance in the preparation of plans, designs, and specifications for needed repairs of the structures.

4.3 Maintenance of Operating Facilities

The City of Berlin is required to inspect all structural works annually and after every major storm or occurrences of any unusual adverse conditions that affect their operation.

4.4 Description of Any Warning System in Effect

No written warning system for the Project was disclosed.

4.5 Evaluation

Minor maintenance is good; however, extensive trespassing by vehicles on the crest, upstream and downstream slopes, and the area immediately downstream of the toe requires attention. The dike is not as well maintained as the main dam.

Extensive trespassing by vehicles on the crest, the upstream slope, the downstream slope, and the area immediately downstream of the toe of the dam is destroying the grassy ground cover and leaving ruts in the ground surface. If the trespassing is not controlled, it may lead to serious erosion and seepage problems.

Two minor seepages near the outlets of the spillway pipe and the corrugated metal pipe underdrains may be indicative of a problem. The seepage that is located more than 100 feet downstream of the toe of the dam may or may not be associated with flow from reservoir, and therefore may not be indicative of a problem and presents no problem to discharge.

The saplings growing on the slopes of the dike could pose a long-term problem if allowed to grow into trees.

to the top of the concrete slab. Inside dimensions of the box are 10.5 feet long by 3.5 feet wide. Two 2.7-foot wide by 2-foot high lower inlets are cast into the ends of the riser section 6.4 feet below the top slab and the two higher-level spillway inlets have a crest 4.0 feet above the crest of the lower inlets. The higher-level inlets are 10.5 feet long and are 1.9 feet high. All spillway openings in the riser are protected with steel trash gate openings to contain floating debris. All visible portions of the concrete riser appear to be in very good condition with no signs of deterioration or corrosion. The outlet end of the 42-inch diameter outlet pipe (see Appendix C - Figures 8 and 9) is reinforced concrete also observed to be in very good condition. The outlet ends of the corrugated metal toe drains discharging to the spillway outlet pipe from downstream face are in good condition.

The emergency spillway (see Appendix C - Figure 15) is an open channel about 100 feet wide at the bottom and with a 1H:1V side slope of exposed rock and 4H:1V side slope of earth embankment to the north and a 4H:1V side slope of earth embankment to the south. The channel bottom appears to be mostly glacial till. Several of the rock exposures in the channel appear to be bedrock, while others are large boulders.

d. Dike. The dike (see Appendix C - Figures 16 and 17) is located on the drainage divide along the west side of the reservoir. The dike is about 1,665 feet long, 14 feet high, and 10 feet wide at the crest. The reservoir elevation at the time of the inspection was well below the upstream toe of the dike. The crest of the dike is covered with grass and has an elevation equal to that of the dam embankment crest. The upstream and downstream slopes of the dike are inclined at 3H:1V. Both slopes are covered with grass and some brush and saplings are beginning to grow on the slopes. Some swampy areas near the downstream toe of the dike are obviously the result of a high natural water table and are not the result of seepage from the reservoir.

e. Reservoir Area. The watershed (see Appendix C - Figure 18) above the reservoir is rolling and heavily wooded. A bathing beach, bathhouse, and boat ramp are located on the north shore of the reservoir; no other structures exist on the shores of the lake. No evidence of significant sedimentation was observed.

f. Downstream Channel. The spillway outlet conduit (see Appendix C - Figure 19) discharges into a riprap-lined plunge pool. Riprap extends in the downstream channel for a distance of about 75 feet from the outlet conduit. Beyond that point are trees and brush growing adjacent to the channel. Downstream from the emergency spillway are trees and brush growing in that channel and presents no problem to discharge.

3.2 Evaluation

Based on the visual inspection, the Project is in good condition.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The Project consists of a dam of intermediate height which impounds a reservoir of intermediate size and a dike 4,150 feet to the northwest of the dam. The watershed above the reservoir is rolling and heavily wooded. The downstream area is rolling and partially wooded.

b. Dam. The Project is an earthen embankment about 46.5 feet high (hydraulic and structural height), 2,935 feet long, and 16 feet wide at the crest. (See Appendix C - Figures 2, 3, and 4.) A sand-and-gravel roadway, completely bare of vegetation, runs along the crest of the dam. The upstream slope of the embankment is inclined at 3H:1V and is covered with grass which is kept mowed. Riprap extends from an elevation about 3 feet above the reservoir level at the time of the inspection to an elevation about 15' below dam embankment crest. The riprap was in good condition. Near the south abutment there are some ruts (see Appendix C - Figures 5 and 6) where a vehicle was apparently driven on the upstream slope during wet weather. The downstream slope is also covered with grass which is kept mowed. Ruts are at many locations on the downstream slope where vehicles have apparently been driven during wet weather. There are also many ruts (see Appendix C - Figure 7) in the relatively flat grassy area immediately downstream of the dam. Two corrugated metal drain pipes (see Appendix C - Figures 8 and 9) discharge at the downstream toe, one on either side of the spillway outlet pipe. Water was flowing from both drain pipes at the time of the inspection. Two minor seepage areas are located on the south side of the spillway outlet pipe. One seepage (see Appendix C - Figure 10) was observed approximately 300 feet south of the bend in the dam and 100 feet downstream from the toe of the dam. It is not known whether this seepage is coming from the reservoir or whether it is natural spring. The north end of the dam is an earthen slope (see Appendix C - Figures 11, 12, and 13) which serves as part of the south bank of the emergency spillway channel. Vehicles have been driven up two paths on this slope, destroying the vegetation and leaving the end of the embankment susceptible to erosion.

c. Appurtenant Structures. A concrete outlet structure (see Appendix C - Figure 14) is located near the center of the dam. This structure serves as a low-level outlet, and two-stage principal spillway, all constructed in one vertical riser. The reservoir drain outlet is a gated 30-inch diameter pipe located at the base of the riser. The mechanical gate operating mechanism mounted on the top of the riser appeared to be well maintained and in good condition. The concrete riser section is 20 feet high from base to the crest of the higher-level spillway and an additional 2.4 feet

The City is required to inspect all structural works of improvement annually and after every major storm or occurrence of any unusual adverse conditions that affect their operation. However, the only manually operated structure at Site No. 1, Dead River Dam, is the low-level reservoir outlet which allows the pool to be drawn down for cleaning or repairs at the site. The principal and emergency spillways function automatically as the reservoir pool elevation changes. The SCS provides consultative assistance to the City of Berlin for the operation of the structures.

2.4 Evaluation

a. Availability. Complete SCS engineering plans and sketches, hydrologic and hydraulic calculations, construction field notes, and detailed geologic data are on file at the SCS Durham office.

b. Adequacy. Field inspection of Site No. 1, Dead River Dam, indicated that the SCS plans and sketches were adequate. Final assessments and recommendations are based upon the SCS plans, sketches, and hydrologic and hydraulic calculations in conjunction with the visual inspection of the dam and dike sites.

c. Validity. The visual inspection disclosed that the present conditions are consistent with the SCS as-built plans and sketches.

SECTION 2
ENGINEERING DATA

2.1 Design

Site No. 1, Dead River Dam, was designed by the U.S. Department of Agriculture, Soil Conservation Service (SCS) in 1968. Design data were found in the SCS Durham, New Hampshire, office. These data consisted of:

(1) Complete design report with all hydrologic and hydraulic calculations (see Appendix B).

(2) Detailed geologic investigations of the dam and dike sites (see Appendix B).

(3) Dam, dike, and emergency spillway design data on 39 sheets and other data include (selected 9 of 39 sheets in Appendix B):

(a) Plans of dike, dam, principal spillway, and emergency spillway, toe drains, and pool.

(b) Sketches of typical sections of dam and dike embankment and emergency spillway.

(c) Profiles along centerline of dike, dike cutoff trench, dam, dam cutoff trench, and emergency spillway.

(d) Detailed listing of quantities of construction materials.

(e) Sketches of fill placement in dam and dike embankments.

(f) Logs of test holes (not readily reproducible).

2.2 Construction

The design plans were revised in 1971 to reflect as-built conditions. Field notes and revisions made to the design plans are available in the SCS Durham office.

2.3 Operation

The City of Berlin is responsible for operation of the dam for structural measures as set forth by an agreement (see Appendix B, pages B-1 to B-5) between the SCS, the project's designer, the New Hampshire Water Resources Board (NHWRB), and the City of Berlin, the sponsor of the Dead River Watershed project.

(6) U/S Channel - The dam spans Jericho Brook and creates Jericho Lake. The watershed above the reservoir is steep and heavily wooded. A bathing beach, bathhouse, and boat ramp are located on the northshore of the reservoir and comprise Jericho Lake Park. No other development exists on the shores of Jericho Lake. The dike is not clearly visible from the dam.

(7) D/S Channel - The channel immediately downstream is about 20 feet in width. The channel bottom is a mixture of sand, gravel, and boulders. Trees and heavy brush cover the valley sides. In the immediate vicinity of the principal spillway outlet erosion of the channel walls is apparent.

k. Emergency Spillway

(1) Type - a grass covered earthen channel having side slopes 1H:1V of exposed rock and 4H:1V of earth embankment to the north and 4H:1V side slope of earth embankment to the south.

(2) Width - 100'

(3) Crest elevation - 1,362.0' MSL

(4) Length of level section - 60' (approximate)

(5) U/S Channel - The approach channel originates at the northeast bank of the reservoir north of the dam and is grass covered.

(6) D/S Channel - The downstream channel is not well defined with standing trees and brush noted. It joins the downstream channel of the principal spillway several hundred yards downstream of the principal spillway outlet.

l. Regulating Outlet. A 60-foot long, 30-inch diameter reinforced concrete pipe serves as reservoir drain, originating at upstream pool bottom with invert at 1,329.3 feet (MSL) and discharges into 42-inch diameter concrete. The crank-operated gate lift mechanism is located on top of the cover of the two-stage drop-inlet riser.

(8) Cutoff - core trench excavated through alluvium, glacial till and decomposed rock to firm bedrock as shown on SCS design plans

(9) Grout curtain - none

(10) Toe drain - two 12" diameter perforated corrugated metal pipes

h. Dike

(1) Type - earthen embankment on unconsolidated glacial deposits along the watershed divide

(2) Length - 1,665'

(3) Height - 14'

(4) Topwidth - 10'

(5) Side Slopes - 3H:1V upstream and downstream

(6) Zoning - 2 zones in dike embankment indicated on SCS design plans (see Appendix B)

(7) Impervious core - none indicated on SCS design plans

(8) Cutoff - core trench excavated through alluvium, glacial till, and decomposed rock to firm bedrock along centerline shown on SCS design plans

(9) Grout curtain - none

(10) Toe drain - none

i. Diversion and Regulating Tunnel - not applicable

j. Principal Spillway

(1) Type - a vertical reinforced concrete two-stage drop-inlet riser having a covered top with two 2'H x 2.7'W rectangular inlets at the lower level and two1.9'H x 10.5'W inlets at the higher level which ultimately discharge into a 42-inch horizontal conduit.

(2) Size - 3.5' x 10.5' drop-inlet riser discharging into a 42-inch diameter horizontal conduit with a length of 204 feet through dam embankment

(3) Crest Elevation - 1,352.0' MSL for first level inlets and 1,356.0' MSL for second level inlets

(4) Gates - none

(5) Low-level - 30-inch diameter reinforced concrete pipe which originates in pool bottom and discharges into the 42-inch conduit.

(4) Length of flood control pool - 4,150

e. Storage (acre-feet)

(1) Recreation pool - 1,240

(2) Flood control pool - 2,800

(3) Principal spillway crest pool - 1,240

(4) Emergency spillway crest pool - 2,800

(5) Top of dam - 4,720

(6) Test flood pool - 4,695

f. Reservoir Surface (acres)

(1) Recreation pool - 132

(2) Flood control pool - 177

(3) Principal spillway crest - 132

(4) Emergency spillway crest - 177

(5) Test flood pool - 208

(6) Top of dam - 215

g. Dam

(1) Type - earthen embankment on unconsolidated glacial deposits with drop-inlet spillway (principal) and grassed emergency spillway; consists of 333,700 cubic yards of fill.

(2) Length - 3,035' (includes 100-foot wide emergency spillway)

(3) Height - 46.5' (hydraulic and structural height)

(4) Topwidth - 16'

(5) Side slopes - 3H:1V upstream and 2.5H:1V downstream

(6) Zoning - 3 zones in dam embankment and riprap on the upstream slope as indicated on SCS design plans.

(7) Core - trapezoidal section consisting of silty sands with a 40' width at base, 10' topwidth, and height of 30'; elevation at top of impervious core is 1,352.0' MSL as shown on SCS design plans.

(1) Low-level outlet (reservoir drain) 30" RCP capacity @ principal spillway elevation - 112 cfs @ 1,352' MSL

(2) Principal (drop-inlet) spillway capacity @ test flood elevation - 302 cfs @ 1,370.9' MSL (low stage: 113 cfs; high stage: 189 cfs)

(3) Emergency spillway discharge @ test flood elevation - 7,673 cfs @ 1,370.9' MSL

(4) Total project discharge @ test flood elevation - 7,975 cfs @ 1,370.9' MSL

(5) Principal (drop-inlet) spillway capacity @ top of dam - 302 cfs @ 1,371.0' MSL (low stage: 113 cfs; high stage: 189 cfs)

(6) Emergency spillway capacity @ top of dam - 7,800 cfs @ 1,371.0' MSL

(7) Total spillway capacity @ top of dam - 8,102 cfs @ 1,371.0' MSL

c. Elevation (feet above MSL as shown on available "as built" SCS plans in Appendix B)

(1) Streambed @ centerline of dam - 1,324.5 (approximate, at downstream toe)

(2) Bottom of cutoff trench - 1,317.0

(3) Maximum tailwater - unknown

(4) Upstream invert low-level outlet - 1,329.3

(5) Recreation pool - 1,352.0 (principal spillway)

(6) Full flood control pool - 1,362.0

(7) Drop-inlet spillway crest - lower level - 1,352.0, higher level - 1,356.0
Emergency spillway crest - 1,362.0

(8) Design surcharge (original design) - 1,371.0

(9) Top of dam - 1,371.0

(10) Test flood pool - 1,370.9

d. Reservoir (feet)

(1) Length of maximum pool - 4,150

(2) Length of pool at principal spillway crest - 3,700 (approximate)

(3) Length of pool at emergency spillway crest - 4,150 (approximate)

c. Size Classification. Intermediate (hydraulic height - 46.5 feet; storage - 4,720 acre-feet) based on criteria (intermediate size corresponds to dam with height ≥ 40 feet and < 100 feet and storage ≥ 1,000 and < 50,000 acre-feet) in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. High Hazard. A major breach could result in extensive property damage and considerable loss of life (10 or more) downstream in the urbanized area of the City of Berlin. Major floods in 1927, 1936, and 1953 on the Dead River, with significantly smaller discharges than the breach discharge used in this report, support this contention (See Section 5.1 f.).

e. Ownership. The Project is owned by the City of Berlin, New Hampshire.

f. Operator. The dam is operated by the City of Berlin Recreation and Parks Department, First Avenue, Berlin, New Hampshire, 03570. Telephone (603) 752-2010.

g. Purpose of the Project. The Project was constructed for the purposes of storing floodwaters and providing recreational opportunities.

h. Design and Construction History. The Project was designed by the Soil Conservation Service (SCS), Durham, New Hampshire office. Construction was begun in May 1969 by Rogers Construction Co., Inc. of Brattleboro, Vermont and the project was 99 percent complete by December 1969. All remaining construction work was completed by September 1970 by the same firm.

i. Normal Operating Procedures. The City of Berlin, as is set forth in the Operation and Maintenance Agreement for Structural Measures (between the City and SCS), is required to inspect all structural works of improvement annually and after every major storm or occurrence of any unusual adverse conditions that affect their operation. The only operable outlet at the Project is the low-level reservoir drain which allows the reservoir pool level to be drawn down for cleaning or repairs at the site. The principal spillway (two-stage riser) and the emergency spillway function automatically as the reservoir pool elevation changes.

1.3 Pertinent Data

a. Drainage Area. The watershed above the dam consists of 6.48 square miles (4,147 acres) of steep forested terrain. No storage areas exist in the watershed above the upstream limit of Jericho Lake. The normal surface area (recreation pool) is 132 acres which constitutes 3.2 percent of the total watershed area.

b. Discharge at Damsite. According to the director of the City of Berlin Park and Recreation Department, the maximum known stage at the damsite occurred at an unknown date when the reservoir pool elevation approximately reached the second stage inlet of the principal spillway. Using the rating curve calculated for the dam, the project discharge was estimated to have been 90 cfs.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual examination indicates the following evidence of potential problems:

(1) Extensive vehicular trespassing on the crest, the upstream slope, the downstream slope, and the area immediately downstream of the toe of the dam is destroying the grassy ground cover and leaving ruts in the ground surface.

(2) Two minor seepages near the outlet of spillway discharge pipe and the two underdrain pipes.

(3) One seepage more than 100 feet downstream from the toe of the dam.

b. Design and Construction Data. Site No. 1, Dead River Dam, was designed by the U.S. Department of Agriculture, Soil Conservation Service (SCS) in 1968. Design data were found in the SCS Durham, New Hampshire, office. These data consisted of:

(1) Complete design report with all hydrologic and hydraulic calculations (see Appendix B).

(2) Detailed geologic investigations of the dam and dike sites (see Appendix B).

(3) Dam, dike, and emergency spillway design data on 39 sheets; include (selected 9 of 39 sheets in Appendix B):

(a) Plans of dike, dam, principal spillway, and emergency spillway, toe drains, and pool.

(b) Sketches of typical sections of dam and dike embankments and emergency spillway.

(c) Profiles along centerline of dike, dike cutoff trench, dam, dam cutoff trench, and emergency spillway.

(d) Detailed listing of quantities of construction materials.

(e) Sketches of fill placement in dam and dike embankments.

(f) Logs of test holes (not readily reproducible).

The design plans were revised in 1971 to reflect as-built conditions. Field notes and revisions made to the design plans are available in the SCS Durham office.

c. Operating Records. Detailed inspections records obtained from the SCS Durham office are in Appendix B.

d. Post-Construction Changes. There is no record of post-construction changes.

e. Seismic Stability. This dam is located in Seismic Zone 2 and in accordance with the Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Dead River Dam is in good condition. The only concerns with respect to the long-term stability of the dam are:

(1) Extensive vehicular trespassing on the crest, the upstream slope, the downstream slope, and the area immediately downstream of the toe of the dam is destroying the grass ground cover and leaving ruts in the ground surface.

(2) Two minor seepages near the outlet of spillway discharge pipe and the two corrugated metal underdrain pipes.

(3) One seepage approximately 300 feet south of the bend in the dam and 100 feet downstream from the toe of the dam may or may not be associated with flow from the reservoir and, therefore, may not be indicative of a problem.

b. Adequacy of Information. The visual examination and the complete design data available are adequate for the purposes of the Phase I inspection.

c. Urgency. The recommendations and remedial measures made in 7.2 and 7.3 below should be implemented by the owner within two years after receipt of this Phase I inspection.

d. Need for Additional Investigation. There is no need for additional investigation for the purposes of this Phase I report.

7.2 Recommendations

The owner should engage a registered professional engineer to investigate the two minor seepages near the spillway outlet and the one seepage which is more than 100 feet downstream from the dam.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Repair ruts and control trespassing on the dam and the area immediately downstream of the dam.

(2) Visually inspect the dam and appurtenant structures and monitor seepage once a month.

(3) Engage a registered professional engineer to make a comprehensive technical inspection of the dam once every two years.

(4) Establish an around-the-clock surveillance program

for use during and immediately after heavy rainfall and also a warning program to follow in case of emergency conditions or imminent dam failure.

(5) Mow and cut saplings on dike embankment seasonally.

(6) Observations at the dam should be made after significant events, but while substantial storage is still being utilized to determine if seepage exists which could not be detected when the reservoir pool is at normal elevation.

7.4 Alternatives

None.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Site No. 1, Dead River Dam (Berlin, NH) DATE June 7, 1979

TIME 1400

WEATHER Sunny, warm

W.S. ELEV. U.S. 1353.1 DN.S. 1321.0

PARTY:

1. Warren Guinan
2. Stephen Gilman
3. Katherine Hivley
4. Pattu Keshevan
5. Ronald Hirschfeld
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	W. Guinan	
2.	Structural Stability	S. Gilman	
3.	Soils & Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Site No. 1, Dead River (Berlin, NH) DATE June 7, 1979

PROJECT FEATURE Dam Embankment NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	1371.0 MSL
Current Pool Elevation	1353.1 MSL
Maximum Impoundment to Date	1356.0 MSL (approximate)
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Extensive vehicle tracks on downstream face of dam at and beyond toe.
Sloughing or Erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	Riprap on upstream face - no failures observed.
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Two minor seepage areas right of spillway outlet pipe
Piping or Boils	None observed
Foundation Drainage Features	
Toe Drains	Two CMP toe drains discharging water on either side of spillway discharge.
Instrumentation System	None observed
Vegetation	Grass on both upstream and downstream slopes. Some grass on crest, but vehicle tracks on crest are bare soil.

PERIODIC INSPECTION CHECKLIST

PROJECT Site No. 1, Dead River (Berlin, NH) DATE June 7, 1979

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	1371.0 MSL
Current Pool Elevation	1353.1 MSL
Maximum Impoundment to Date	1356.0 MSL (approximate)
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	None observed
Sloughing or Erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toes	None observed
Unusual Embankment or Downstream Seepage	No water against upstream side of dike
Piping or Boils	None
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Grass on crest; grass, brush, and small trees on upstream slope and downstream slopes.

PERIODIC INSPECTION CHECKLIST

PROJECT Site No. 1, Dead River (Berlin, NH) DATE June 7, 1979

PROJECT FEATURE Principal Spillway (Two-stage riser) NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good - no indications of movement.
Spalling	None visible
Visible Reinforcing	None
Rusting or Staining of Concrete	None visible
Any Seepage or Efflorescence	None visible
Joint Alignment	Good - no apparent movement.
Unusual Seepage or Leaks in Gate Chamber	Not visible
Cracks	None visible
Rusting or Corrosion of Steel	None visible - galvanized steel in good condition.
b. Mechanical and Electrical	Hand-operated crank serves as a gate lift mechanism for low-level reservoir drain; located on concrete platform on top of two-stage riser. Appears to be in good condition.
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Site No. 1, Dead River (Berlin, NH) DATE June 7, 1979

PROJECT FEATURE Emergency Spillway NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Glacial till
b. Weir and Training Walls	None - earth spillway
General Condition of Concrete	None
Rust or Staining	None
Spalling	None
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None
Drain Holes	None
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some trees in channel
Floor of Channel	Glacial till
Other Obstructions	None

PROJECT Site No. 1, Dead River (Berlin, NH)

DATE June 7, 1979

PROJECT FEATURE Reservoir

NAME W. Guinan

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	None visible
Changes in Watershed Runoff Potential	None visible
Upstream Hazards	None visible
Downstream Hazards	Urbanized area of City of Berlin Converse Building
Alert Facilities	None visible
Hydrometeorological Gages	None visible
Operational & Maintenance Regulations	None visible

APPENDIX B

ENGINEERING DATA

1977

Jericho Brook
Berlin, New Hampshire
June 24, 1977

Dead River - Topdressing

Dam only.

Recommendations for this season.

Use 500#/acre of "Sul-po-mag". This is sulfate of potash magnesia.

This may be purchased at Merrimack Farmers' Exchange in 80# bags. The ton price is $125. There may be other local sources.

There are 6½ acres involved in the dam. Of these, 2½ acres are on the upstream face of the dam and 4½ on the downstream face.

Basis for recommendations.

The dam is covered with a good population of birdsfoot trefoil. The vigor of these plants is very poor on the upstream face and fairly good but deteriorating on the downstream face.

Soil tests taken on 5/27/77 revealed a deficiency of magnesium and potassium in relation to the needs of birdsfoot trefoil.

The objective of the recommendation is to try and increase the plant cover of birdsfoot trefoil in order to prevent erosion and to prevent encroachment of woody plant species that would require annual eradication.

Recommendations for next spring and early summer.

A topdressing of 300#/acre of muriate of potash next spring is very desirable. If this can be accomplished, further topdressing should be based on soil tests taken every other year.

One ton of muriate of potash would cover the entire dam. It costs approximately $170/ton and is readily available through local grain companies.

Attachment

MAINTENANCE CHECKLIST FOR P.L. 566 FLOOD CONTROL STRUCTURES

This maintenance checklist is a guide for determining the maintenance required for Public Law 566 flood control structures in New Hampshire. It doesn't take the place of experience and judgment and is not inclusive. Items of a difficult nature to check, such as principal spillway conduit condition, are not included. Intensive checks of these items are necessary at proper intervals. Review of As Built drawings, the design folder, structure history, and previous maintenance reports should be part of the inspection. Prompt maintenance is a vital part of safe and effective operation.

Except where otherwise indicated, completion of this form may be facilitated by ranking maintenance items on a 1 to 4 basis where

1 = satisfactory
2 = satisfactory, but check carefully at next inspection
3 = requires maintenance this season
4 = requires immediate attention.

WATERSHED DEAD RIVER SITE 1 DATE 6/12/78

INSPECTED BY Keith MacPherson, Richard Haldeman, Mitchell Berkowitz, M. L. Glidden

1. GENERAL ITEMS

Access Road.	3
Site Fencing.	2
Traffic Conditions.	3
Vandalism Control.	1
Trash Control.	3

COMMENTS Gate is being installed across left end of dam.

2. RESERVOIR

Timber stand at reservoir.	2
Debris and slash.	3
Sediment level in relation to low stage inlet	2

COMMENTS Brush in the inlet and outlet channel of the Emergency Spillway should be removed. Debris and slash on the upstream embankment.

Riche Building, 99 Main St., Lancaster, NH 03584

June 19, 1975

Mr. James Smith
City Manager
City Hall
Berlin, NH 03570

Dear Mr. Smith:

Attached is the annual Operations and Maintenance Inspection Report for the Dead River Watershed conducted on June 17, 1975.

The report lists items that require attention by the City as their obligation under the Operation and Maintenance Agreement of August 26, 1968.

I trust that you will see that these actions are carried out and following completion will send me a letter to that effect.

Sincerely,

Calvin J. Perkins
District Conservationist

cc: W. Wheeler, Acting City Engineer
✓C. Pingle, Assistant State Conservationist (WR)

OPERATIONS AND MAINTENANCE INSPECTION REPORT
Site 1 (Jericho Lake)
Dead River Watershed Project
May 28, 1976

An operation and maintenance inspection of Site 1 (Jericho Lake) in the Dead River Watershed, Berlin, NH was conducted on May 28, 1976. The inspection was made by representatives from the local sponsoring organization, the Coos County Conservation District, and the Soil Conservation Service. Those present were:

Mitchell Berkowitz, Berlin Recreation Director
Randell Sargent, Coos County Conservation District
Richard Haldeman, District Conservationist, USDA, SCS
Eddie Wood, USDA, SCS
Tillman Marshall, USDA, SCS
Nick Luhtala, USDA, SCS

Following is a list of items discussed and the necessary action needed:

1. Remove debris from the principle spillway trash rack.

2. Close off, repair erosion and revegetate old access road below dam.

3. Close off and vegetate present road running across the top of the dam.

4. Improve vegetative cover on the dam slopes by:

   A. Removing woody vegetation which is starting to develop in several areas.

   B. Lime and fertilize slopes, especially the upstream slope. Lime and fertilizer should be applied according to soil test recommendations which can be obtained through the County Agent's office, Coos County Extension Service, Lancaster, NH. However, if this information can not be obtained a general recommendation of 2 tons per acre (or 100 lbs. per 1,000 sq. ft.) of ground limestone and 400 lbs. per acre (or 10 lbs. per 1000 sq. ft.) of 10-10-10 or equivalent fertilizer may be used.

5. Remove alders and other woody vegetation that is starting to grow in the stream overflow area, between the upstream slope of the dam and the inlet stream.

Fi6

...ding, 99 Main St., Lancaster, NH 03584

June 3, 1976

Mr. James Smith
City Manager
City Hall
Berlin, NH 03570

Dear Mr. Smith:

Attached is the annual Operations and Maintenance Inspection Report for the Dead River Watershed conducted on May 28, 1976.

The report lists those items which require maintenance by the City. I trust that these items will be carried out as soon as possible under the City's obligation in the Operation and Maintenance Agreement, for this project, of August 26, 1968.

When the items listed are completed please send me a letter so indicating.

If additional technical assistance is needed to carry out any of these maintenance items please feel free to call on us.

Very truly yours,

Richard S. Haldeman
District Conservationist

BERLIN RECREATION AND PARKS DEPARTMENT
FIRST AVENUE BERLIN, NEW HAMPSHIRE 03570 TELEPHONE 752-2010

MITCHELL A. BERKOWITZ, DIRECTOR

all of the undesirable vegetation along the dam and the over-flow areas. Much of our new operations and maintenance program includes the 1968 project agreement. In future years we hope to improve this type of maintenance based on the changes in the park's areas.

Our summer workers also controlled the erosion along the new access road with the introduction of bark. This has already started new vegetation which should enhance the roadway next year. Two important areas of erosion were also brought to a control. The first was the entrance way which has been carefully cribbed and seeded. The second area was along the steep slope of the parking lot. Again, cribbing and seeding along with a drainage ditch has halted any erosion. During the 1977 summer we will complete the parking lot erosion control, re-landscape the roadway and develop 12 special tent campsites in the upper field.

As always, I look foward to another year at Jericho Lake Park and the needed improvements we hope to fulfill. Your inspection in may 1977 should also provide us with additonal recommendations.

Cordially,

Mitchell A. Berkowitz,
Director

CC: Mayor Laurier Lemontange
City Manager James C. Smith

BERLIN RECREATION AND PARKS DEPARTMENT
FIRST AVENUE BERLIN, NEW HAMPSHIRE 03570 TELEPHONE 752-2010

MITCHELL A. BERKOWITZ, DIRECTOR

17 December 1976

Mr. Richard S. Halderman
District Conservationist
U.S.C.S.
Piche Building
99 Main Street
Lancaster, N.H.

Dear Mr. Halderman,

The Recreation Department Summer Staff has worked very diligently to complete many of the Inspection recomendations. To date we have removed debris from the principle spillway trash rack and consider this as part of our weekly operation once the park is open each year. In the Early spring this would be checked once the access road is clear of ice. The Old access road has been partially closed off and we intend to completely close this road as well as the road on top of the dam. All erosion in those areas has been initially halted and further repairs and vegetation will commence in the late spring and early summer. One of the major difficulties in this area is accessibility by ORV's. During the 1977 summer we feel that we will be better able to control their use through some additional campsite development and barrier improvments.

During the [illegible] we were able to apply lime to dam slopes and [illegible] eroded areas, limed, added loam and re-seeded bare spots along the dam. This will continue during the 1977 summer.

In the area of woody vegetation control I feel we went beyond the recommendations and will continue to control

8. IMPACT BASIN, SAF, BOX INLET, & MISCELLANEOUS CONCRETE STRUCTURES

(specify) Diversion channel structures

Concrete: inside and out	Cracking 1; Spalling 1; Other deterioration 1; Excessive movement (check joints) 1; Waterstops 1; Joint sealant 1; Other 1.
Trashracks: low and high stage	Condition of protective coatings 1; Corrosion 1; Damaged parts 1; Condition of fastenings 1; Need of gratings due to beaver 1; Safety condition (protruding fastenings, sharp edges, etc.) 1; Other 1.
Gates: including lifting device, stem, guides, disc, flap	Condition of protective coating ___; Corrosion ___; Damaged parts ___; Condition of fastenings ___; Stem alignment ___; Operation ___; Lubrication ___; Wood decay ___; Other ___.
Structure Drainage:	Report under "Embankment and Other Drains"
Structure, Railing, Grates, Barriers, etc.	Condition of protective coating ___; Corrosion ___; Damaged parts ___; Condition of Fastenings ___; Wood decay ___; Safety condition (protruding fastenings, sharp edges, etc.) ___; Other ___.
Safety Items:	Condition of warning signs ___; Condition of safety equipment ___; Other ___.

COMMENTS 1 stop log in stream below structure- channels for stop logs rusty- paint

9. CHANNEL

Stream obstructions.	1
Debris in stream.	1
Sediment bars controlled.	1
Plunge pool stability.	1
Fish habitat appurtenances	2

Riprap -- Report under "Riprap" (item 4)

COMMENTS

7. RISER

Caution Be extremely careful when using ladders. Check condition before using. Ladders are sometimes broken, loose, corroded, and or slippery.
Use safety harness.

Ladders: inside and out	Condition of protective coating ?; Corrosion ?; Damaged parts ?; Loose ?; Other ?.
Concrete: inside and out	Cracking 1; Spalling 1; Other deterioration ___; Excessive movement (check joint at riser and conduit) ___; Other ___.
Trashracks: low and high stage	Condition of protective coatings 1; Corrosion 1; Damaged parts 1; Condition of fastenings 1; Need of gratings due to beaver 1; Safety condition (protruding fastenings, sharp edges, etc.) 1; Other ___.
Manhole:	Condition of protective coatings 3; Corrosion ___; Damage 1; Lock operable ?; Other ___.
Gate: including lifting device, stem, guides, disc	Condition of protective coating 2; Corrosion 1; Damaged parts 1; Condition of fastenings 1; Stem alignment 1; Lubrication 1; Operation ___; Other ___.
Safety Items:	Condition of warning signs ___; Condition of safety equipment ___; Other ___.

COMMENTS Trash in racks need cleaning. Didn't check ladder - No wrench to get M.H. cover off. Manhole cover rusty. Gate lift should be painted & checked for operation. Grease & oil if necessary.

5. VEGETATION

	Dam	Emergency Spillways left	Emergency Spillways right 1/	Dike	Outlet Channel	~~Water~~ flood way	Other (Parking lot)
Condition of stand (including need for lime and fertilizer)	3	3	—	—	1	2	3
Undesirable vegetation	3	3	—	—	1	3	1
Drainage (surface)	1	1	—	—	1	1	1
Erosion 2/	1	1	—	—	1	1	1
Sedimentation	1	1	—	—	1	1	1
Condition of planting	—	—	—	—	—	—	—
Pest control	1	1	—	—	1	1	1
Fire control	1	1	—	—	1	1	1

COMMENTS Entire dam should be fertilized based on soil test results.
Entire dam may need to be limed based on soil test results.
Shrub growth on dam should be eradicated.
Spillway should be limed and fertilized based on soil test results.
Shrub growth in waterway should be controlled.
Shrub growth in spillway should be controlled.
Bank above parking lot should be limed & fertilized based on soil test.

6. EMBANKMENT, STRUCTURAL, & OTHER DRAINS

		Dam left	Dam right 1/	Other (____)	Other (____)
Depth of Flow (in inches above invert)	With any obstruction				
	Without any obstruction	½	½	—	—
Turbidity of Discharge (yes, no)	With any obstruction	No	No	—	—
	Without any obstruction	No	No	—	—
Condition of Protective Coating	Outside	2	2	—	—
	Inside	1	1	—	—
Obstruction in Flow (yes, no)		No	No	—	—
Animal Guard Condition		1	1	—	—
Outlet Condition		—	—	—	—

Retarding Pool Elevation (ft. msl)_____ or_____(ft.) above / below _____

Other_____

COMMENTS Seepage around riser.

1/Looking downstream.
2/Including wave, surface, stream, manmade, and livestock erosion.

3. EMBANKMENT AND EXCAVATED SLOPES

(Report riprap and vegetation and erosion condition under Items 4 and 5.)

	Dam	Dike	Emergency Spillways 1/ left	Emergency Spillways 1/ right	Other (____)	Other (____)
Sliding or sloughing	2	—	—	—	—	—
Holes (rodent and other) (check especially at embankments)	2	—	—	—	—	—
Excessive settlement (embankments)	1	—	—	—	—	—
Cracks						
Traverse	1	—	—	—	—	—
Longitudinal	1	—	—	—	—	—
Seepage 2/	1	—	—	—	—	—
Piping 2/	1	—	—	—	—	—

COMMENTS could be gouging by ice 200' rt of riser @ 40' long - top about half way up fill. 2nd area 170' LT of PI of curve. 2 holes & burrowing downstrm face (rt side) opposite rock rib outcrop. Vehicle tracks should be filled in - particularly those running up & down slope

4. RIPRAP

	Displ. of Rock	Loss of Spalls	Loss of Bedding	Erosion of Found.	Break-down of Rock
Dam					
Upstream berm	2	2	1	1	1
Principal Spillway Outlet	—	—	—	—	—
Embankment Gutters					
left	—	—	—	—	—
right.	—	—	—	—	—
Emergency Spillway					
location_____	—	—	—	—	—
location_____	—	—	—	—	—
Waterways					
location floodway	2	2	1	1	1
location Diversion channel	1	1	1	1	1
Outlet Channel	1	1	1	—	—
Other_____	—	—	—	—	—

COMMENTS Riprap around riser displaced. Some minor displacement in riprap on upstream face along floodway.

1/Looking downstream.
2/Check especially at downstream face of embankments.

MAINTENANCE CHECKLIST FOR [illegible]6 FLOOD CONTROL STRUCTURES

This maintenance checklist is a guide for determining the maintenance required for Public Law 566 flood control structures in New Hampshire. It doesn't take the place of experience and judgment and is not inclusive. Items of a difficult nature to check, such as principal spillway conduit condition, are not included. Intensive checks of these items are necessary at proper intervals. Review of As Built drawings, the design folder, structure history, and previous maintenance reports should be part of the inspection. Prompt maintenance is a vital part of safe and effective operation.

Except where otherwise indicated, completion of this form may be facilitated by ranking maintenance items on a 1 to 4 basis where

1 = satisfactory
2 = satisfactory, but check carefully at next inspection
3 = requires maintenance this season
4 = requires immediate attention.

WATERSHED DEAD RIVER SITE 1 DATE 1977
INSPECTED BY

1. GENERAL ITEMS

Access Road.	
Site Fencing.	4
Traffic Conditions.	3
Vandalism Control.	3
Trash Control.	

COMMENTS UPSTREAM FACE OF DAM, EMER. SPWY FLOODWAY. DOWNSTREAM FACE - Hole under cradle 4" wide 3" deep flowing full, travel access top of dam, old road to dam not fenced as required in access road construction

2. RESERVOIR

Timber stand at reservoir.	2
Debris and slash.	2
Sediment level in relation to low stage inlet	2

COMMENTS water along beach look clearer this year.

8. IMPACT BASIN, SAF, BOX INLET, & MISCELLANEOUS CONCRETE STRUCTURES

(specify) Recirculating System - Inelt and dam

Concrete: inside and out	Cracking 1 ; Spalling 1 ; Other deterioration 1 ; Excessive movement (check joints) 1 ; Waterstops 1 ; Joint sealant 1 ; Other 1 .
Trashracks: low and high stage	Condition of protective coatings 1 ; Corrosion 1 ; Damaged parts 1 ; Condition of fastenings 1 ; Need of gratings due to beaver 1 ; Safety condition (protruding fastenings, sharp edges, etc.) 1 ; Other 1 .
Gates: including lifting device, stem, guides, disc, flap	Condition of protective coating 2 ; Corrosion 2 ; Damaged parts 2 ; Condition of fastenings 2 ; Stem alignment ; Operation 3 ; Lubrication 2 ; Wood decay 2 ; Other 2 .
Structure Drainage:	Report under "Embankment and Other Drains"
Structure, Railing, Grates, Barriers, etc.	Condition of protective coating -- ; Corrosion -- ; Damaged parts -- ; Condition of Fastenings -- ; Wood decay -- ; Safety condition (protruding fastenings, sharp edges, etc.) -- ; Other -- .
Safety Items:	Condition of warning signs ; Condition of safety equipment ; Other .

COMMENTS

9. CHANNEL

Stream obstructions.	1
Debris in stream.	1
Sediment bars controlled.	1
Plunge pool stability.	1
Fish habitat appurtenances	---

Riprap -- Report under "Riprap" (item 4)

COMMENTS

7. RISER

Caution Be extremely careful when using ladders. Check condition before using. Ladders are sometimes broken, loose, corroded, and or slippery.
Use safety harness.

Ladders: None
inside and out

Condition of protective coating___; Corrosion___; Damaged parts___; Loose___; Other___.

Concrete:
inside and out

Cracking 0 ; Spalling 0 ; Other deterioration 0 ; Excessive movement (check joint at riser and conduit) 0 ; Other 0 .

Trashracks:
low and high stage

Condition of protective coatings 1 ; Corrosion 0 ; Damaged parts 1 ; Condition of fastenings 1 ; Need of gratings due to beaver 0 ; Safety condition (protruding fastenings, sharp edges, etc.) 1 ; Other 0 .

Manhole:

Condition of protective coatings 3 ; Corrosion ___; Damage___; Lock operable___; Other___.

Gate:
including lifting device, stem, guides, disc

Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Lubrication___; Operation___; Other___.

Safety Items:

Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS Paint manhole cover.

INLET TO RECIRCULATING PIPE SYSTEM - Remove debris from trash rack. (3)

5. VEGETATION

	Dam	Emergency Spillways left	Emergency Spillways right 1/	Dike	Outlet Channel	Water way	Other (_____)
Condition of stand (including need for lime and fertilizer)	3						
Undesirable vegetation	3	3		4			
Drainage (surface)		3					
Erosion 2/	3	3					
Sedimentation	3	3					
Condition of planting							
Pest control							
Fire control							

COMMENTS Pockets need to be drained and revegetated. Remove woody plants from the dam. Bare spots should be topdressed and reseeded. There is erosion from damage to vegetation by ATV's. Remove the woody vegetation from the dike.

6. EMBANKMENT, STRUCTURAL, & OTHER DRAINS

		Dam left	Dam right 1/	Other (_____)	Other (_____)
Depth of Flow (in inches above invert)	With any obstruction	None			
	Without any obstruction	¼"	½"		
Turbidity of Discharge (yes, no)	With any obstruction	No	No		
	Without any obstruction	No	No		
Condition of Protective Coating	Outside	2	2		
	Inside	2	2		
Obstruction in Flow (yes, no)		No	No		
Animal Guard Condition		1	1		
Outlet Condition		1	1		

Retarding Pool Elevation (ft. msl)_____ or_____(ft.) above / below _____

Other_____

COMMENTS_____

1/Looking downstream.

2/Including wave, surface, stream, manmade, and livestock erosion

3. EMBANKMENT AND EXCAVATED SLOPES

(Report riprap and vegetation and erosion condition under Items 4 and 5.)

	Dam	Dike	Emergency Spillways 1/ left	Emergency Spillways 1/ right	Other (____)	Other (____)
Sliding or sloughing	2	—	2	—	—	—
Holes (rodent and other) (check especially at embankments)	3	—	1	—	—	—
Excessive settlement (embankments)	3*	—	—	—	—	—
Cracks						
Traverse	1	—	2	—	—	—
Longitudinal	1	—	2	—	—	—
Seepage 2/	1	—	3	—	—	—
Piping 2/	1	—	2/	—	—	—

COMMENTS Ruts in the spillway should be filled. If the spillway operates, ruts in the outlet channel will accelerate erosion. The city should consider fencing or erecting barriers to keep ATV's out of the spillway and off the dam.

*Fill in low areas on top of the dam.

4. RIPRAP

	Displ. of Rock	Loss of Spalls	Loss of Bedding	Erosion of Found.	Break-down of Rock
Dam					
Upstream berm	2	2	2	2	2
Principal Spillway Outlet	2	2	2	2	2
Embankment Gutters					
left	-	-	-	-	-
right	-	-	-	-	-
Emergency Spillway					
location _____	-	-	-	-	-
location _____	-	-	-	-	-
Waterways					
location Floodway	2	2	2	2	2
location Jericho Br.	2	2	2	2	2
Outlet Channel	2	2	2	2	2
Other _____	—	—	—	—	—

COMMENTS

1/Looking downstream.

2/Check especially at downstream face of embankments.

Operations and Maintenance Inspection Report
Site 1 (Jericho Lake)
DEAD RIVER WATERSHED PROJECT

JUNE 17, 1975

An operation and maintenance inspection of Site 1 (Jericho Lake) in the Dead River Watershed, Berlin, N. H. was conducted on June 17, 1975. The inspection was made by representatives from the local sponsoring organization and the Soil Conservation Service. Included were:

James Smith, City Manager
Maurice Wheeler, Acting City Engineer
Mitchell Berkowitz, Berlin Recreation Director
Calvin Perkins, District Conservationist, USDA, SCS
Charles Dirdo, USDA, SCS
Wallace Jolly, USDA, SCS
Thomas Rogers, USDA, SCS
Nick Luhtala, USDA, SCS

Following is a list of items discussed and the necessary action needed:

1. Remove the small amount of debris from the principal spillway trash rack and along the rip-rap material of the dam.

2. Cut the alders and other woody plant growth that is encroaching the emergency spillway and in a few spots along the dam.

3. All roadways through the emergency spillway, along the downstream side of the dam, and across the top of the dam should be seeded and mulched to provide these areas with a vegetative cover.

4. The upstream slope of the dam should be fertilized to encourage a more dense vegetative cover. Apply 10 lbs. per 1000 square feet of 15-10-10 commercial fertilizer. Application should be made as soon as possible to obtain maximum benefit this growing season.

5. The borrow area where the new access road is being constructed is also void of desirable vegetative cover. This area should also be fertilized, but the slope of the dam is the most critical at this time.

6. It was noted the repairs to the spalling on top of the concrete riser have been made.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Piche Building, 99 Main St., Lancaster, NH 03584

SUBJECT: Operations and Maintenance Inspection - Dead River Watershed

DATE: May 21, 1974

TO:
Mr. James Smith
City Manager
City Hall
Berlin, New Hampshire 03570

Dear Mr. Smith:

Attached is the annual Operations and Maintenance Inspection Report for the Dead River Watershed conducted on May 17, 1974.

The report lists items that require attention by the City as their obligation under the Operation and Maintenance Agreement of August 26, 1968.

I trust that you will see that these actions are carried out and following completion will send me a letter to that effect.

Sincerely,

Calvin J. Perkins
District Conservationist

cc: M. Wheeler
C. Dingle
W. Nelson
K. MacPherson

Operations and Maintenance Inspection Report
Site 1 (Jericho Lake)
DEAD RIVER WATERSHED PROJECT
May 17, 1974

An operation and maintenance inspection of Site 1 (Jericho Lake) in the Dead River Watershed, Berlin, NH, was conducted on May 17, 1974. The inspection was made by representatives from the local sponsoring organization and the Soil Conservation Service. Included were:

Maurice Wheeler, Assistant City Engineer
Mitchell Berkowitz, Berlin Recreation Department
Gus Rooney, Member, Berlin Recreation Commission
Keith MacPherson, Design Engineer, USDA, Soil Conservation Service
Calvin J. Perkins, District Conservationist, USDA, Soil Conservation Service

Following is a list of items discussed and the necessary action needed.

1. Remove the accumulation of debris from the principal spillway trash rack and along the rip-rap material of the dam and in the approach to the emergency spillway.

2. Remove the accumulation of bottles and litter at the trash barrels near the top of the dam.

3. Repair the two areas of concrete spalling on top of the principal spillway. Directions for making this repair are contained in a letter from Mr. Dingle of SCS to Mr. Brungot, City Engineer, dated June 26, 1973. (Copy attached)

4. Remove sediment from the entrance to the water circulation pipe at the water control structure.

5. Repair and vegetate wheel track ruts on the downstream slope of the dam to prevent further erosion.

6. Keep vehicles off dam by placing large boulders close together at the pipeline end of dam. Once vehicle traffic across top of dam has stopped then vegetate the top of dam.

7. The most serious item is to develop better vegetative cover in the emergency spillway area and borrow areas adjacent to the spillway. This would Area II as shown on the original Plan of Vegetation. This area is approximately 20 acres in size and should be fertilized to promote grass growth. Apply 250 lbs./acre of 15-10-10 or closest equivalent. This application should take place immediately to be effective in this growing season. If this is not done erosion will begin to occur and should the emergency spillway function severe problems could occur without the presence of good vegetative cover.

8. A visit to the dike indicated that no maintenance was required at this time.

Ficke Building, 99 Main St., Lancaster, N. H. 03584

October 30, 1973

Mr. Sylvio Croteau, Mayor
City of Berlin
City Hall
Berlin, N. H. 03570

Dear Mr. Croteau:

On October 4, 1973 Soil Conservation Service personnel and Maurice Wheeler representing Clarence Brungot visited the Dead River Site # 1, Jericho Lake. During the visit several operational observations were made that require the immediate attention of the city. They are as follows:

1. A stemguide bracket is missing on the inside of the concrete riser. This needs repair or replacement to assure proper functioning of the sluice gate. This equipment was made by:

Coldwell - Wilcox Division
W. S. Rockwell Co.
200 Eliot Street
Fairfield, Conn. 06430

The damage part is a cast iron stemguide bracket, Part # A-307, Drawing No. SK-1389, (QQ-I-652, Class 30). Refer to Drawing No. C-SP-904 of the original specifications. Please have repaired as soon as possible.

2. There are two areas of spalling on top of the concrete riser. These should be repaired and a letter of June 26, 1973 to Clarence Brungot explains the details of making the repairs. (Copy attached.)

3. The stop logs should be removed from the diversion channel during the winter months. The sections of old metal pipe that have floated into the diversion channel should be removed.

4. The water storage at the site should be sufficient to cover the recreation circulation pipe with at least 4 feet of water before winter to prevent freezing of this pipe system.

I trust that you will see that this work is performed promptly to assure proper functioning of the flood control structure. If I can be of any assistance please contact me.

Sincerely,

Calvin J. Perkins

1 Incl
as

Calvin J. Perkins
District Conservationist

CJP:r

cc: Clarence Brungot, City Engineer, Berlin
Charles Dingle, SCS, Durham
Walt Nelson, SCS, Durham

...ne Building, 99 Main St., Lancaster, N. H. 03584

May 24, 1973

Mr. Clarence Brungot
City Engineer
Public Works Department
City Hall
Berlin, N. H. 03570

Dear Mr. Brungot:

Since the City of Berlin will soon be having a change in the City Manager position I am sending the attached annual Operations and Maintenance Inspection Report for the Dead River Watershed to you.

The report list items # 1, 2, 3, 4, 5, 6, that require action by the City of Berlin.

I trust that you will see that these actions are carried out and following completion will send me a letter to that effect.

Sincerely,

Calvin J. Perkins
District Conservationist

CJP:r

cc: C. Dingle, Asst. State Conservationist (W), SCS, Durham, N. H.
W. Jolly, State Conservation Engineer, SCS, Durham, N. H.
W. Nelson, Soil Conservationist, SCS, Durham, N. H.

OPERATIONS AND MAINTENANCE INSPECTION REPORT
of Site 1 (Jericho Lake)
Dead River Watershed Project
May 22, 1973

An operation and maintenance inspection of Site 1 (Jericho Lake) in the Dead River Watershed was conducted on May 22, 1973. The inspection was made by representatives from the local sponsoring organization and the Soil Conservation Service. Included were:

Clarence Brungot, Berlin City Engineer
Maurice Wheeler, Assistant to City Engineer
Walter Nelson, USDA, Soil Conservation Service
Calvin J. Perkins, USDA, Soil Conservation Service

Following is a list of items discussed and the necessary action needed.

1. Remove heavy debris accumulation from principal spillway trash rack and on the rip-rap material along the dam and in the approach to the emergency spillway.

2. Two areas on top of the concrete riser (each about 2 square feet in area) were showing evidence of spalling. These areas were from $\frac{1}{2}$ to $\frac{1}{2}$ inch deep and had water within. Cause of this action is unknown and correction procedure was not decided upon.

3. In general the vegetation looked better than last year. However, it is apparent that legume will not grow on the exposed upstream slope of dam. Grasses in this area and other flat areas is present but appeared to need fertilization. Suggested fertilizing a total of 11 acres with 20-10-10 at a rate of 200 lbs./acre. Downstream slope of dam has good legume and grass cover.

4. Clean debris from water control structure, retrive stop logs that are in downstream channel, and remove sections of old steel pipe in upstream and downstream channel.

5. Slight bank erosion at end of rip-rap on left side of channel below water control structure. This should be watched closely and if conditions increase the rip-rap should be extended.

6. Old road along base of dam should be seeded to prevent erosion and discourage use of this area by unauthorized vehicles.

7. No vegetation on top of dam, however, it appeared that this was causing no problem.

8. Impossible to control vehicle traffic to the site. Cable at gate on Route 110 is destroyed as fast as it is installed.

9. Although records indicate that a plaque was ordered by Water Resources Board in 1971 there is no evidence of installation. The question of who is responsible for installation was brought up but could not be answered.

10. Inclement weather prohibited a visit to the dike area. Mr. Brungot stated that the dike was in good vegetative cover and that brush was not encroaching on same.

Pickz Building, 99 Main St., Lancaster, N. H. 03584

June 26, 1972

Mr. Joseph Burke
City Manager
City Hall
Berlin, N. H. 03570

Dear Mr. Burke:

Attached is the annual Operations and Maintenance Inspection Report for the Dead River Watershed conducted on June 20, 1972.

The report lists items # 1 and 2 that require maintenance work by the local sponsors.

Following completion of the work please forward me a letter to that effect.

Sincerely,

Enclosure

Calvin J. Perkins
District Conservationist

cc: C. Brungot, Public Works Superintendent, Berlin, N. H. 03570
C. Dingle, Asst. State Conservationist (W), SCS, Durham, N. H. 03824

Operations and Maintenance Inspection Report

of Site 1 (Jericho Lake)

Dead River Watershed Project

JUNE 20, 1972

An operation and maintenance inspection of Site 1 (Jericho Lake) in the Dead River Watershed was conducted on June 20, 1972. The inspection was made by representatives from the local sponsoring organization and the Soil Conservation Service. Included were:

Mayor Sylvio Croteau, Berlin
Joseph F. Burke, Berlin City Manager
Maurice Wheeler, Berlin
Calvin J. Perkins, USDA, Soil Conservation Service

Following is a list of items discussed and the necessary action needed.

1. Remove debris from principal spillway and on the rip-rap material along the dam.

2. Remove stones under planks at the water control structure in the Jericho Brook channel plus the section of metal pipe that floated downstream and lodged at the structure.

3. Vegetation is not good on upstream slope of dam but may improve during summer growth period. Good vegetation on downstream slope of dam. Winter kill of vegetation is apparent on the downstream flat areas and in the emergency spillway and adjacent borrow area. There is no present damage being done by the lack of vegetation cover but this bears a close watch.

4. The top of the dam is being used extensively by vehicular traffic of various types. They enter onto the dam via the City pipeline and this type of traffic is almost impossible to control. All traffic at the main entrance to the site has been stopped except for ATV and similiar two-wheeled transportation. With so much traffic on the top of the dam it is void of vegetation but this is not causing any problems at the present time.

OPERATIONS & MAINTENANCE INSPECTION REPORT
OF SITE 1 (JERICHO LAKE)
DEAD RIVER WATERSHED PROJECT

June 9, 1971

An operation and maintenance inspection of Site 1 (Jericho Lake) in the Dead River Watershed was conducted on June 9, 1971. The inspection was made by representatives from the local sponsoring organizations and the Soil Conservation Service. Included were:

Clarence Brungot, City of Berlin
Forrest Hodgdon, N. H. Water Resources Board
Peter Merkes, N. H. Water Resources Board
Henry Stematel, USDA, Soil Conservation Service
Charles Brown, USDA, Soil Conservation Service
Ray Wenninger, USDA, Soil Conservation Service
Edward Hutchinson, USDA, Soil Conservation Service
Charles Holden, USDA, Soil Conservation Service
Walter Zwearcan, USDA, Soil Conservation Service

Following is a list of items discussed and the necessary action needed.

1. The dike was in good repair with an excellent vegetative cover established. Woody plant growth should be control in the future by either mowing or use of spray.

2. Trash to be cleared away from the principal spillway and along the dam at the water edge. The N. H. Water Resources Board agreed to take care of this item.

3. Two washouts on the back side of the dam above the principal spillway pipe need repair. The City of Berlin agreed to make this repair by filling and seeding the washcut holes. Also to remove stones and smooth out material down slope from the washouts.

4. Inspection of dam, floodway, emergency spillway and borr area indicated no need for maintenance at this time.

Being early in the growing season, it was difficult to determine the quality of the grass cover. It is possibl that there will be a need for fertilizing some of these areas another year.

5. There was no vegetative cover in wheel tracks over the entire length of the dam. This condition will continue to exist until vehicle traffic can be controlled. The condition, however, was not considered harmful to the dam.

Piche Building, 99 Main Street, Lancaster, New Hampshire 03584

June 30, 1971

Mr. Clarence Brungot
Public Works Superintendent
City Hall
Berlin, New Hampshire 03570

Dear Mr. Brungot:

Attached is the annual Operations and Maintenance Inspection Report for the Dead River Watershed conducted on June 9, 1971.

The report lists two items on Site 1 that require maintenance work by the local sponsors.

Following completion of the work, please forward me a Letter of Certification and the approximate cost for doing the work. The cost information will be helpful to us in estimating operation and maintenance in future projects.

Sincerely,

Edward F. Hutchinson

Edward F. Hutchinson
District Conservationist

Enclosure - O&M Inspection Report
Site 1, Dead River Watershed Project

cc: Coos Conservation District, Lancaster, N. H.
C. Dingle, Asst. State Conservationist (W), Soil Conservation Service, Durham, New Hampshire

USDA:SCS: E. F. Hutchinson:hs

6/71 Inspection Report

Piche Building, 99 Main Street, Lancaster, New Hampshire 03584

June 30, 1971

Mr. Peter Merkes
New Hampshire Water Resources Board
Concord, New Hampshire 03301

Dear Mr. Merkes:

Attached is the annual Operations and Maintenance Inspection Report for the Dead River Watershed conducted on June 9, 1971.

The report lists two items on Site 1 that require maintenance work by the local sponsors.

Following completion of the work, please forward me a Letter of Certification and the approximate cost for doing the work. The cost information will be helpful to us in estimating operation and maintenance in future projects.

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Enclosure - O&M Inspection Report
Site 1, Dead River Watershed Project

cc: Coos Conservation District, Lancaster, N. H.
C. Dingle, Asst. State Conservationist (W), Soil Conservation Service, Durham, New Hampshire

USDA:SCS: E. F. Hutchinson:hs

U.S DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

DESIGN REPORT SUMMARY

I. Watershed Data

A Structure Class	C	
B. Drainage Area	4.147	Ac.
C. Time of Concentration - T_c	2.4	Hrs.*
D. Hydrologic Curve Number - C_n		
1. Moisture Condition II*	68	
2. Moisture Condition III*	85	

II. Principal Spillway

A. Conduit		
1. Inside Dia.	42	In
2. Length	304.33	Ft.
B. Riser		
1. Inside Dimensions	3.5 X 10.5	Ft.
2. Height (Floor to Crest)	29.0	Ft.
C. Weir Length	8.0	Ft.
D. Orifice Dimensions	2 - 3¼ x 32	In.
E. Reservoir Drain Size	20	In.
F. Type of Energy Dissipater	PLUNGE POOL	

III. Emergency Spillway

A. Width	100	Ft.
B. Side Slopes	4:1 EARTH 1:1 ROCK	
C. Length of Level Section	60	Ft.
D. Exit Slope	.04	Ft/Ft
E. Max. Velocity in Exit Section @ D. H. W.	2.33	Ft/Sec.
F. Duration of Flow thru Emer. Spillway @ D H. W.	4.2	Hrs.
G. Frequency of Use	LESS THAN ONCE IN 100 YRS	

IV. Earth Fill

A. Height	46	Ft.
B. Volume		C. Y.
C. Compaction	ZONES 2, 3, 4, 5 CLASS V	
	ZONES 1 CLASS A	

FILL PLACEMENT

*AS PER WORK PLAN

Rev. 8-68

U. S. DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

This multiple-purpose dam is located in Coos County, New Hampshire, on the Jerico Brook tributary of the Dead River. The site is approximately four miles northwest of Berlin, New Hampshire.

Sheet 4 of this report, together with the Mt. Washington, New Hampshire, 15-minute quadrangle published by the U. S. Geological Survey, may be used to locate the structure more definitely.

A summary of pertinent design information is given on sheet 2 of this report.

This is the only proposed floodwater retarding dam in the Dead River Watershed. This will be a multiple-purpose structure designed to retard a 100-year frequency storm without discharge occurring in the emergency spillway.

The results of the hydrologic and hydraulic computations are given on sheet 3 of this report.

The primary structure consists of a zoned compacted earthfill with a cutoff through alluvium, glacial till, and decomposed rock to firm bedrock. A drainage system is located under the downstream portion of the earthfill to control the phreatic surface and to collect seepage.

The principal spillway is a drop inlet, closed conduit structure consisting of a two-stage, reinforced, concrete riser, 42-inch diameter reinforced concrete water pipe, and a riprapped plunge pool.

The emergency spillway is designed as an earth and rock cut in the left abutment. An engineering cost analysis was performed which resulted in the least combined cost of fill and emergency spillway rock excavation.

V I

DESIGN REPORT

DEAD RIVER
WATERSHED PROJECT
SITE 1
COOS COUNTY
NEW HAMPSHIRE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

INDEX

Modification No. 4 was issued to provide for over-runs in common excavation, rock excavation, and floodway rock excavation.

Modification No. 5 was issued to provide for over-runs in concrete for the circulation pipe and rock excavation for the circulation pipe.

Modification No. 6 was issued to provide for the construction of a concrete cut-off wall adjacent to the left pier of the drop structure. This was deemed necessary to minimize abutment leakage around the drop structure.

Modification No. 7 was issued to provide for an over-run in riprap for the diversion channel.

Modification No. 8 was issued to allow compensation for a claim submitted by the contractor on Bid Item 8 and Bid Item 16. The contractor based his claim on changed conditions on both items. Bid Item 8 was excavation for the circulation pipe. Backfilling of this item was subsidiary to the excavation item. It was designated that the excavation be backfilled with selected granular material around the pipe. The material contained a great deal of cobbles and boulders making it extremely difficult to provide suitable granular backfill. Granular backfill was obtained from another source with Modification No. 8 providing compensation for additional cost incurred by increased haul distance.

Bid Item 16 was earthfill. Bedrock was exposed above grades shown on the plans creating a shortage of fill. The borrow area had to be expanded in order to obtain the necessary material. The contractor claimed a changed condition due to the presence of the ledge and filed for compensation due to lost efficiency and extra wear on equipment, etc., due to working on bedrock and the confined area of the expanded borrow area. Compensation was granted for approximately one half of the amount claimed. Presently the Contracting Officer's final decision is pending. It appears as though the contractor will have to go to the courts in order to obtain any further compensation.

The contractor completed the job well within the allotted time. He actually worked during a 206 calendar day period out of 341 calendar days.

Arthur N. Luhtala
Project Engineer

ANLUHTALA:pak

At first the contractor attempted to place the drain fill around a form constructed out of sheet steel and angle iron that was to be dragged along the trench by a bulldozer. This method did not prove to work. It was extremely difficult to keep the form moving along the centerline of the trench and when there was drain pipe in the form the friction of drain fill particles tended to keep the entire unit moving as one solid mass. This approach was then abandoned and plywood panels were used to complete the job.

The drain fill was supplied by Lessard Sand and Gravel from Gorham, New Hampshire, although the fine drain fill was trucked from Guildhall, Vermont.

The principal spillway pipe was furnished by Interpace Corporation, Wharton, New Jersey. The pipe was a 42" pre-stressed cylinder pipe (SP-5) double wrap.

Northeastern Culvert Corporation of Westminster, Vermont, supplied the bituminous coated corrugated metal pipe and the trash racks.

Bancroft and Martin, Inc., of South Portland, Maine, supplied the reinforcing steel, cast iron and asbestos cement pipe along with the appurtenances for the circulation system.

Coldwell-Wilcox Company, a division of W. S. Rockwell Company, Fairfield, Connecticut, supplied the back pressure gate.

The E. L. LeBaron Foundry Company of Brockton, Massachusetts, supplied the manhole assembly.

The quality of furnished materials was very good.

The contractor's overall performance was excellent. The experience, equipment, organization and supervision provided was of high quality. The relations between SCS and the contractor were excellent. The Service should not hesitate in awarding future contracts to this contractor.

Eight (8) modifications were issued on this job. Modification No. 1 resulted due to an over-run in the quantity of reinforcing steel and a change in drain trench dimensions. The width of the drain trench had to be increased in order that the flow area required by design be maintained.

Modification No. 2 was issued to apply vegetative treatment on the dike and related areas.

Modification No. 3 was issued to provide plugs for the access tees of the circulation pipe. These were apparently overlooked in quantity summaries.

Available land rights forced the borrow pit extension into an area where excavation was very difficult. This area was located on the northwest border of Borrow Area A. Numerous boulders and the presence of bedrock caused the extreme difficulty. If it had been possible to extend the pit in a northerly direction, I believe that this would have been a more favorable source. This area was not as confined and it appeared as though there was less oversize material present.

In future contracts that require considerable quantities of fill, I suggest that borrow areas be designed to supply at a minimum one and one half times the estimated fill requirement. It is easier to make a borrow area smaller during construction operations than it is to make it larger.

Shrinkage factors, excess amounts of unsuitable material from borrow pits, and other unforeseen factors warrant the need for adequate quantities of available borrow on any particular job.

The concrete was supplied by Brideau Ready Mix of Berlin, New Hampshire.

Six (6) concrete cylinders were broken after seven (7) days with an average strength of 3,460 psi. The minimum seven day break was 3,360 psi and the maximum was 3,750 psi.

Eighteen (18) concrete cylinders were broken after twenty-eight (28) days with an average strength of 4,310 psi. The minimum twenty-eight day break was 3,600 psi and the maximum break was 5,340 psi.

The drainage system for this job consisted of a four (4) foot wide trench drain with a double drain filter. The coarse drain fill was encased by an eight (8) inch layer of fine drain fill. It was extremely difficult to maintain this eight-inch layer with any uniformity due to the nature of the existing foundation soils. Numerous boulders and cobbles are typical of many New Hampshire soils. In the future I suggest that designers allow a minimum of one (1) foot for fine drain fill in a double filter design. This would be much easier to control in the field, allowing placement with less chance of contamination. Contamination appeared to be the most difficult thing to control in placement of the fine drain fill.

Plywood forms were utilized in placement of the drain fill. As drain fill was placed around the plywood sections, the forms would be raised and back filled again. A grad-all proved to be an extremely versatile machine for this operation because of the ability to tilt the bucket in all directions.

Borrow sources on the job were infested with boulders and oversize material. Specifications allowed the use of material up to eighteen (18) inches in size. A large vibratory roller, as specified by construction specifications, attained required compaction with reasonable efficiency.

The material in borrow areas was very dense. Double pushing of scrapers and on occasions triple pushing was utilized in loading operations. Along with ripping this provided for an efficient earth moving operation. It is estimated that ten thousand (10,000) cubic yards per day was moved on occasion. The average production was in the range of thirty-five hundred (3500) cubic yards per day.

A total of seventy-six (76) compaction tests were made. Eleven (11) tests showed compaction below an acceptable density. Most of the unsatisfactory tests resulted with material being on the dry side of optimum. This necessitated adding water to the fill to obtain satisfactory densities.

Zone 1 required a minimum density of 95% of Standard Proctor. Eighteen (18) tests were taken with only two (2) failing. The average of all acceptable densities was 101.2% of Standard Proctor.

Zones 2, 3, 4 and 5 required class V compaction as defined by construction specification 5. In the field this was evaluated by Standard Proctor control due to the nature of the material. The soil had enough silt so that a definite sharp crested Proctor curve could be established. Ninety-five (95) percent of Standard Proctor was considered as acceptable.

In Zones 2 and 3, fifty-two (52) tests were taken with only eight (8) failing to meet 95%. The average of all acceptable densities was 100.5% of Standard Proctor.

In Zones 4 and 5, of the dike, six (6) tests were taken with only one (1) test failing. The average of all acceptable densities was 105.3% of Standard Proctor.

A shortage of earth fill developed on the job. Bedrock appeared at elevations above the grades shown in the plans in Borrow Area A, the major borrow source, thus decreasing the amount of available fill. Another factor was that approximately seventeen thousand (17,000) cubic yards of muck had to be removed from the foundation instead of an anticipated two thousand (2,000) cubic yards. This resulted in excavating Borrow Area A deeper than expected along with having to extend the pit beyond the limits indicated on the plans.

The contract provided for two hundred and eighty (280) calendar days of performance time to complete the work. Work commenced on May 26, 1969. A winter shutdown was issued on December 11, 1969, with approximately ninety-nine (99) percent of the work complete. The contractor used just over sixty-eight (68) percent to perform this amount of work. Performance time again commenced on June 15, 1970, with all remaining construction being completed between August 17, 1970, and August 28, 1970. The final value of the contract was $651,100.59.

In addition to winter shutdowns, the contractor's work was suspended because of weather for a total of five (5) days, all occurring during November 1969. The contractor was also granted sixty-one (61) additional days of performance time due to contract modifications.

Personnel directly concerned with the work were as follows:

Vernon A. Knowlton, Contracting Officer, New Hampshire Water Resources Board, Concord, New Hampshire
Norman A. McDermott, Project Manager, Rogers Construction Co., Inc., Brattleboro, Vermont
Glenn Gibbs, General Superintendent, Rogers Construction Co., Inc., Brattleboro, Vermont
Walter J. Zwearcan, Government Inspector, Soil Conservation Service, Berlin, New Hampshire
Daniel P. Preece, Alternate Government Inspector, Soil Conservation Service, Plymouth, New Hampshire
Arthur N. Lahtala, Government Representative and Project Engineer, Soil Conservation Service, Berlin, New Hampshire

Other personnel were assigned to the job from time to time as required for assistance in inspection and layout work.

The contractor furnished good equipment for the job. The major items of equipment include:

a. Crawler tractors: Two D-8H's with ripper attachments, 82-40, D-7, D-5, JD-450, and other tractors as needed.
b. Rubber-tired dozers, Cat. 834-B and 824-B.
c. Front end loader, Cat. 988.
d. Backhoes, Koehring 1 yd^3, Drott 40, Dynahoe 160, and Grad-all backhoes.
e. SPV-7 vibratory roller.
f. Cat. 14G road grader.
g. 4-Terex TS-24 double barreled scrapers.
h. Gardner Denver 900 cfm wagon drill.
i. 6 large dump trucks (10-15 cu.yd. capacity).
j. Miscellaneous equipment such as a water wagon, pumps, small compressor, vibrating and tamping hand compactors, chain saws, sand blasting equipment, and other necessary equipment as required.

Plymouth, N.H..

ENG - Construction Report, Site No. 1, Dead River Watershed — January 26, 1971

Henry S. Stamatel
State Conservation Engineer
Soil Conservation Service
Durham, New Hampshire 03824

The location of this site is in northern New Hampshire in the city of Berlin, Coos County. This dam is a multiple purpose dam with recreation being the secondary purpose. The job was contracted by the New Hampshire Water Resources Board under Project Agreement No. 12-10-270-75. The City of Berlin and the Coos County Soil Conservation District were sponsors of the work.

The City of Berlin cost shared 23.46% of the costs incurred by construction of the dam and dike, with the Soil Conservation Service paying the remaining 76.54% of the costs. The City of Berlin and SCS cost shared on a 50-50 basis on construction of the circulation system which is considered as a basic recreation facility. The floodway was constructed with SCS paying 100% of the costs because the intended nature is specifically for flood control purposes.

A public viewing of the site was conducted on January 21, 1969. The unique thing about this viewing was that snow machines were required for access to this remote site. Snow depths of seven feet or more on the level were reported at the time of the site showing.

Bids for this job were opened on February 7, 1969. The following shows the bidders and the amount of their respective bids:

Rogers Construction Co., Inc., Brattleboro, Vt.	$564,602.38
Caledonia, Inc., St. Johnsbury, Vermont	736,[illegible]56.00
Cappy-Simone, Inc., Freeport, Long Island, N.Y.	747,[illegible]8.10
Welch & Corr Construction Corp., West Springfield, Massachusetts	774,347.30
Weaver Brothers Construction Co., Inc., Concord, NH	834,996.05
The engineer's estimate was	566,996.55

Contract No. WRB-SCS-26 was awarded to Rogers Construction Company, Inc. of Brattleboro, Vermont, on February 27, 1970.

V RECORDS

The Sponsor will maintain in a centralized location a record of all inspections performed both individually and jointly by the Sponsor and the Service, and of all significant actions taken by the Sponsor with respect to operation and maintenance. The Service may inspect these records at any reasonable time.

VI GENERAL

A. The Sponsor will:

1. Prohibit the installation of any structures or facilities that will interfere with the operation or maintenance of the structural measures.

2. Obtain prior Service approval of the Plans and Specifications for any alteration or improvement to the structural measures.

3. Obtain prior Service approval of any agreement to be entered into with other parties for the operation or maintenance of all or any part of the structural measures, and provide the Service with a copy of the agreement after it has been signed by the Sponsor and the other party.

B. Service personnel will be provided the right of free access to the structural measures at any reasonable time for the purpose of carrying out the terms of this Plan.

C. The responsibilities of the Sponsor under this Plan are effective simultaneously with the acceptance of the works of improvement in whole or in part.

III ESTABLISHMENT PERIOD (continued 2)

resulting from major erosion damage, (4) major revegetation due to failure to obtain an adequate vegetative cover, and (5) restoring areas with significant erosion caused by unusual flow (volume, recurrence or extended period of time) in emergency spillways.

F. No action with respect to needed repairs during the Establishment Period will be taken by the Sponsor or the Service which would lessen or adversely affect any legal liability of any contractor or his surety for payment of the cost of the repairs.

IV INSPECTIONS AND REPORTS

A. During the Establishment Period the Sponsor and the Service will jointly inspect the structural measures at least annually and after unusually severe floods or the occurrence of any other unusual condition that might adversely affect the structural measures. It is desirable the annual inspections be performed during the month shown below. Any supplemental inspections then determined necessary will be scheduled and agreed to at that time.

May
(Month)

B. After the Establishment Period the structural measures will be inspected annually by the Sponsor, preferably during the month shown below, and after unusually severe floods or the occurrence of any other unusual condition that might adversely affect the structural measures.

May
(Month)

C. After the Establishment Period the Service may inspect the structural measures at any reasonable time.

D. A written report will be made of each inspection. The report of joint inspections will be prepared by the Sponsor with the assistance of the Service. A copy of each report will be provided by the party preparing the report to the other party within ten days of the date on which the inspection was made.

III ESTABLISHMENT PERIOD (continued)

2. Repairs determined by the Service to have been occasioned by improper operation or maintenance, or both.

3. Repairs applicable to municipal or industrial water supply or to any other purpose for which construction costs are not authorized to be paid for in whole or in part with funds appropriated to the Service.

4. Repairs that are mutually determined by the Sponsor and the Service as being items of normal maintenance rather than major repair and are not therefore in keeping with the spirit and intent of the Establishment Period provisions.

B. The Establishment Period for structural measures (exclusive of any associated vegetative work) is a period of three years ending at midnight on the third anniversary of the date on which the structural measure is accepted.

C. The Establishment Period for vegetative work associated with a structural measure is a period from date of acceptance of the initial vegetative work to midnight of the date on which the Service writes the Sponsor advising that an adequate vegetative cover has been obtained. However, this period shall not exceed two growing seasons or the end of the Establishment Period for the associated structural measure whichever is greater in time.

D. As used in the two preceding paragraphs, and elsewhere in this Plan, the following words have the meanings described below:

ACCEPTED, ACCEPTANCE: The date structural or vegetative measures are accepted from the contractor when a contract is involved, or the date structural or vegetative measures are completed to the satisfaction of the Service when force account operations are involved.

ADEQUATE VEGETATIVE COVER: A minimum of seventy percent (70%) cover of the desirable species, with no active rilling that cannot be controlled by the vegetation.

E. Major repair may involve such things as (1) repairing separated joints, cracks or breaks in the principal spillway, (2) correcting seepage, (3) replacing significant backfill around structures

OPERATION AND MAINTENANCE PLAN

I OPERATIONS

A. The Sponsor will be responsible for and will operate or have operated without cost to the Service the structural measures in compliance with any applicable Federal, State and local laws, and in a manner that will assure that the structural measures will serve the purpose for which installed as set forth in the Work Plan.

B. The Service will, upon request of the Sponsor and to the extent that its resources permit, provide consultative assistance in the operation of the structural measures.

II MAINTENANCE

A. The Sponsor will:

1. Be responsible for and promptly perform or have performed without cost to the Service except as provided in Paragraph III, Establishment Period, all maintenance of the structural measures determined by either the Sponsor or the Service to be needed.

2. Obtain prior Service approval of all plans, designs and specifications for maintenance work involving major repair.

B. The Service will, upon request of the Sponsor and to the extent that its resources will permit, provide consultative assistance in the preparation of plans, designs and specifications for needed repair of the structural measures.

III ESTABLISHMENT PERIOD

A. During an Establishment Period, as herein defined, the Service will bear such part of the cost of any needed major repairs to the structural measures, including associated vegetative work, as is proportionate to the original construction costs borne by the Service in the construction of the structural measures except that the Service will not bear any of the cost for:

1. Repairs to channels or portions thereof which do not have permanent linings such as concrete, riprap, or grouted rock.

OPERATION AND MAINTENANCE AGREEMENT
FOR
STRUCTURAL MEASURES

THIS AGREEMENT made on August 26, 1968 is between the Soil Conservation Service, United States Department of Agriculture, hereinafter referred to as the Service, and the following organizations, hereinafter referred to as the Sponsor:

City of Berlin, New Hampshire
Coos County Conservation District

The Sponsor and the Service agree to carry out the plan on the attached four pages for the operation and maintenance of structural measures in the Dead River Watershed Project, State of New Hampshire. The measures covered by this agreement are identified as:

one multiple purpose structure plus Jericho Brook diversion channel, diversion dike and floodway, known as Site No. 1, Dead River Watershed, located in Berlin, Coos County, New Hampshire, along Jericho Brook approximately 1.3 miles west (upstream) of the intersection of Route #110 and Jericho Brook.

Name of Sponsor City of Berlin, New Hampshire

By Earl F Gagne Title Mayor

This action was authorized at an official meeting of the Sponsor named immediately above on August 26, 1968 at Berlin, New Hampshire

Attest Mary J Wheeler Title City Clerk

Name of Sponsor Coos County Conservation District

By Edwin C Tuttle Title Chairman

This action was authorized at an official meeting of the Sponsor named immediately above on Dec 3 1968 at Lancaster, N.H.

Attest William E Tuttle Title Secretary (Pro Tem)

Soil Conservation Service, United States Department of Agriculture

By [illegible] Title State Conservationist

U.S. DEPARTMENT OF AGRICULTURE – SOIL CONSERVATION SERVICE

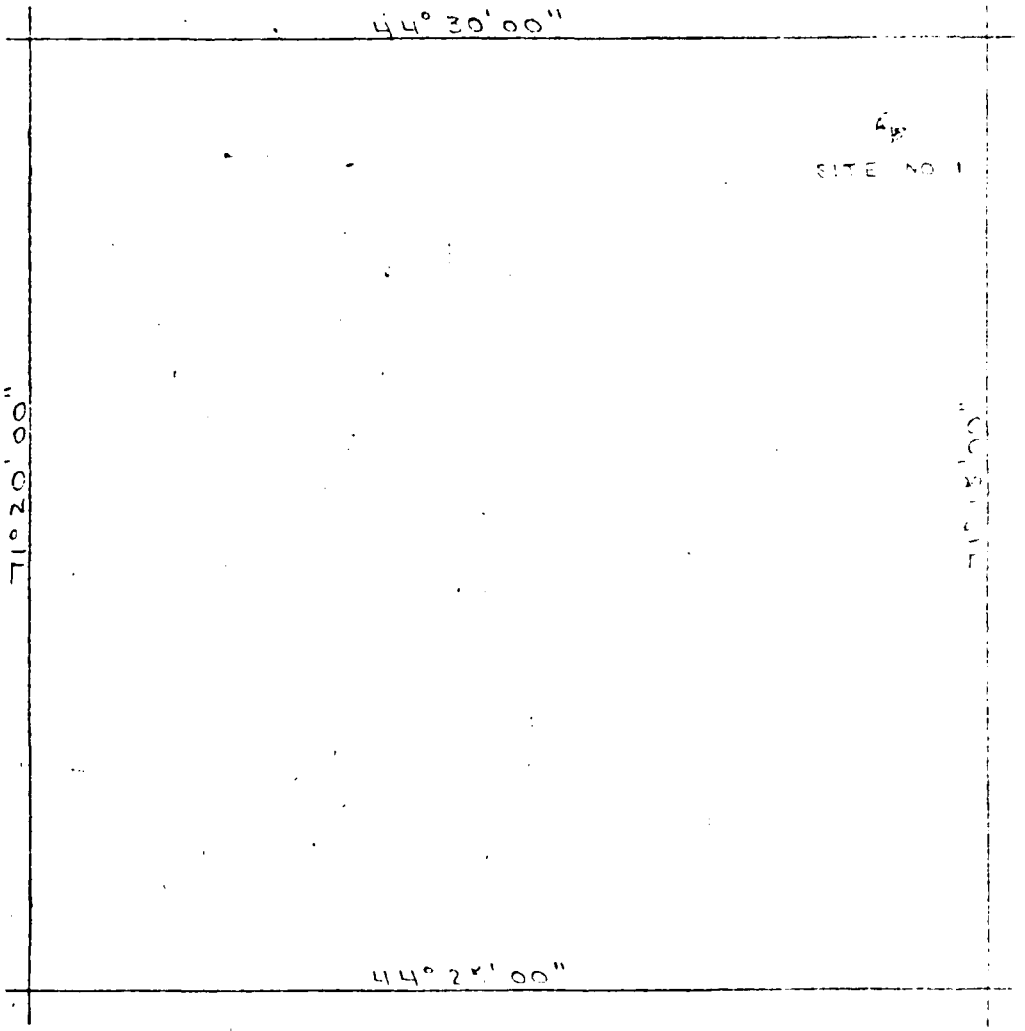
Item	Description	Elevation	Storage Acre-Feet	Storage Inches	Inflow Acre-Feet	Inflow c.f.s.	Outflow c.f.s.	Time of Peak
	100 YEAR EMERGENCY + 1236 AC-FT EXPLORATION STORAGE	1352.0	132			–	–	–
	STRUCTURAL	1356.0	152	569	1.65	–	–	88
		1362.0	178	1559	4.51	–	–	270
	AMC II RAISED TO 1362.0 FOR ECONOMIC REASONS							
[1]	1 of 5	1362.21	180	1587	4.60	4.49	4575	315
	AMC II – AS PER WORK PLAN							
[1]	1 of 5	1371.0	215	2464	10.08	18.57	16272	9075
	AMC II AS PER WORK PLAN. ROUNDED FROM 1370.7 TO 1371.0							

10.06 Days

[1] ROUTINGS STARTED AT 6 DAY DRAWDOWN FROM E.S. CREST

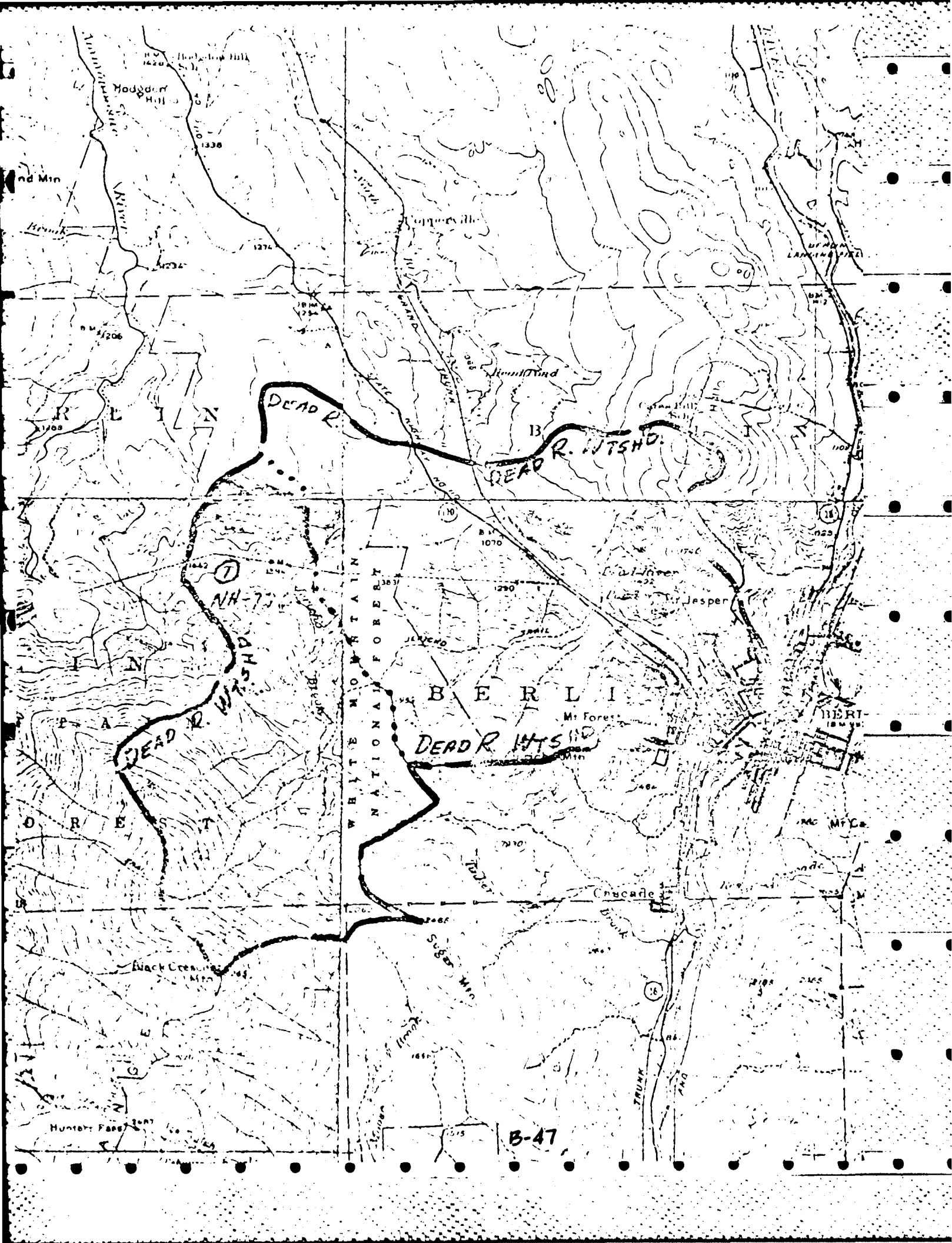
U. S DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

DEAD RIVER WATERSHED
MULTIPLE PURPOSE DAM - NO. 1
COOS COUNTY
NEW HAMPSHIRE



Reference:
U.S.G.S. 15' Quadrangle
Mt. Washington, New Hampshire

Sheet


DEAD R.
DEAD R. WTSHD.
NH-7
DEAD R. WTSHD.
DEAD R WTSHD
WHITE MOUNTAIN NATIONAL FOREST
Jasper
Cascade
B-47

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470668

STATE NH		PROJECT		
BY RW	DATE	CHECKED BY	DATE	JOB NO. NH-770-L
SUBJECT				SHEET ____ OF ____

LAYOUT CONTENTS

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

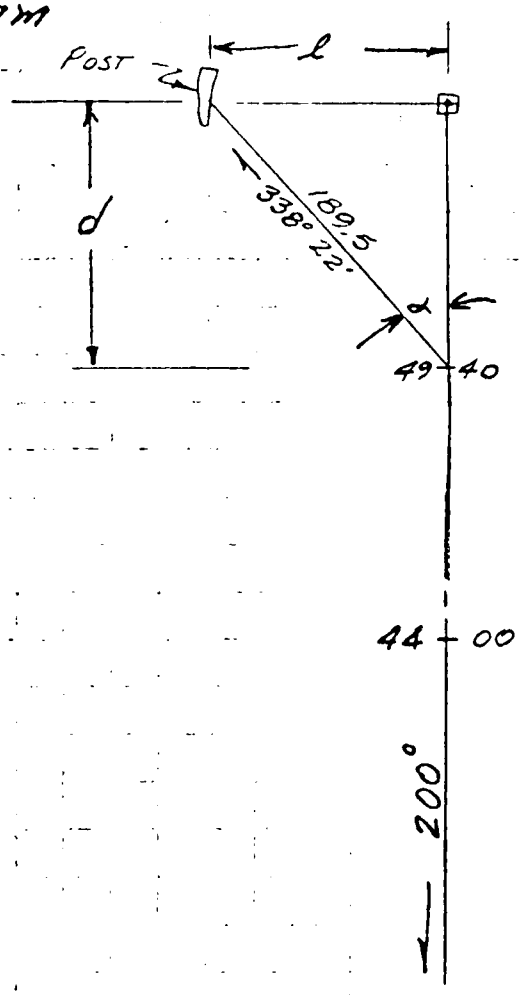
GPO 1958 O—470868

STATE		PROJECT		
N.H.		Deal A Site 1		
BY	DATE	CHECKED BY	DATE	JOB NO
HSS	2/26/68	RW	2-28-68	NH-770P

SUBJECT

SHEET ___ OF ___

Location of Post @ Range 3&4
& Lot 14&15
with respect to Base Line of Survey @
Dam



$\alpha = 200^\circ + 180^\circ - 338^\circ 22 = 41^\circ 38'$ ✓

$\ell = 189.5 \sin 41^\circ 38'$
$= 189.5 \times 0.66436 = 125.896'$ ✓ SAY 125.9

$d = 189.5 \cos 41^\circ 38'$ ✓
$d = 189.5 \times 0.74741 = 141.634'$ SAY 141.6

Station of Post along ℄ of Survey

B-49

Station (49+40) + 1+41.6 = 50+81.6

COMPUTATION SHEET
SCS-522 REV 5-58

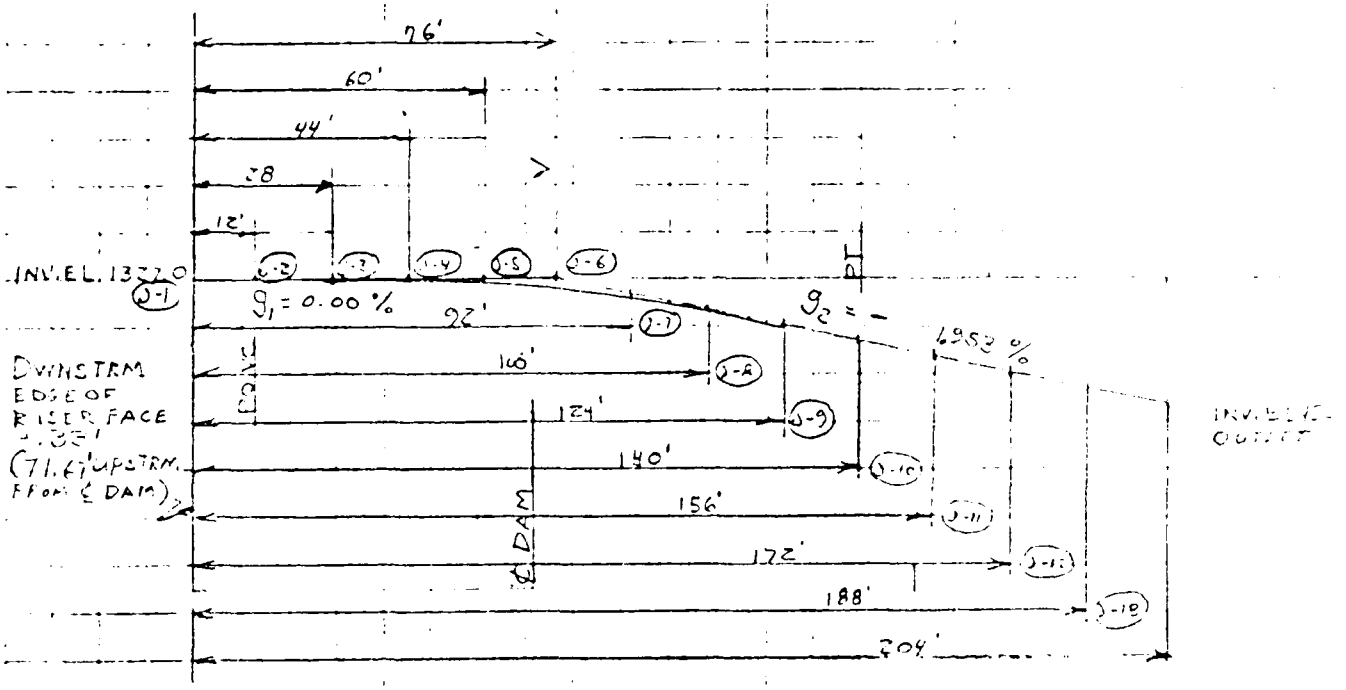
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
U. H.		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO
P.W.	6-19-63	[illegible] RAW	7-1-63	U-[illegible]-L

SUBJECT

PRINCIPAL SPILLWAY LAYOUT

SHEET ... OF ...



$$M = \frac{L}{800}(G_1 - G_2) = \frac{178}{800}(0.00 + 1.953) = .312$$

$$Z_3 = M\frac{D^2}{(L)^2} = .312\,\frac{256}{4096} = .019$$

$$Z_4 = .312\,\frac{1024}{4096} = .078$$

$$Z_5 = .312\,\frac{2304}{4096} = .176$$

$$Z_6 = .312\,\frac{4096}{4096} = .312$$

$$Z_7 = .312\,\frac{6400}{4096} = .488$$

$$Z_8 = .312\,\frac{9216}{4096} = .702$$

$$Z_9 = .312\,\frac{12544}{4096} = .956$$

$$Z_{10} = .312\,\frac{16384}{4096} = 1.248$$

NOTE: ABOVE DIMENSIONS FOR LENGTHS OF PIPES ARE BASED ON NOMINAL LENGTHS.

	JOINT NO.	DISTANCE FROM D/S FACE OF RISER	INVERT OF 42" CONDUIT
	J-1	0.33	1327.00
TOYC	J-2	12.33	1327.05
	J-3	28.33	1326.98
	J-4	44.33	1326.92
	J-5	60.33	1326.82
	J-6	76.33	1326.69
	J-7	92.33	1326.51
	J-8	108.33	1326.30
	J-9	124.33	1326.04
PT	J-10	140.33	1325.73
	J-11	156.33	1325.49
	J-12	172.33	1325.12
	J-13	188.33	1324.71
	OUTLET	204.33	1324.33

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
NEW HAMPSHIRE	DEAD RIVER WATERSHED PROJECT			
BY	DATE	CHECKED BY	DATE	JOB NO.
RWM	12/28/67	SMW	6-18-68	SITE 1

SUBJECT
EM. SP. CURVE DATA (INLET)

SHEET 1 OF 2

1. $\Delta = 37^\circ \quad \frac{\Delta}{2} = 18^\circ 30'$

2. $R = 125'$

3. $D = \frac{5729.65}{R} = \frac{5729.65}{125} = 45.83720$ ~~45.83720~~ 45.83664

4. $L = 100\left(\frac{\Delta}{D}\right) = 100\,\frac{37}{45.8372} = 80.722 = \underline{80.72}$

5. $T = R \tan\frac{\Delta}{2} = (125)(.33460) = 41.825 = \underline{41.82}$

6. $E = R\,\text{exsec}\frac{\Delta}{2} = (125)(.05449) = 6.81125 = \underline{6.81}$

7. $M = R\,\text{vers}\frac{\Delta}{2} = (125)(.05168) = 6.46 = \underline{6.46}$

8. $Lc = 2R\sin\frac{\Delta}{2} = (250)(.31730) = 79.325 = \underline{79.33}$

$$d_{100} = \frac{18^\circ 30'}{80.720} = 22.91873^\circ$$

$d_1 = .2291873^\circ$

$d_{25} = (.2291873)(25) = 5.72968 = 5^\circ 43' 78''$

$d_{5.72} = (.2291873)(5.72) = 1.3109^\circ = 1^\circ 18.7'$

$C_{25} = 2R\sin d_{25} = (250)(.09961) = 24.96'$ (.09983)

$C_{5.72} = 2R\sin d_{5.72} = (250)(.02280) = 5.65$ ~~5.72~~ (.02289)

Station	Chord in feet	Deflection ∠ in degrees	Deflection ∠ in deg. & min.
PC 3+00	—	0.000	0° 00'
3+25	24.96	5.729	5° 44'
3+50	24.96	11.458	11° 28'
3+75	24.96	17.187	17° 12'
PT 3+80.72	5.72	18.498	18° 30'
PI = (3+00) + 41.82 =		3+41.82	

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

STATE		PROJECT		
NEW HAMPSHIRE		DEAD RIVER WATERSHED PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO.
RWM		RW	6-18-68	SITE 1

SUBJECT
EM SPILLWAY CURVE DATA (OUTLET)

SHEET 2 OF 2

1. $\Delta = 35°$ $\quad \frac{\Delta}{2} = 17°30'$

2. $R = 250'$

3. $D = \frac{5729.65}{250} = 22.9156$

4. $L = 100\left(\frac{\Delta}{D}\right) = 100\ \frac{35}{22.9156} = 152.7144$

5. $T = R \tan \frac{\Delta}{2} = (250)(.31530) = 78.825$

6. $E = R\,\mathrm{Exsec} \frac{\Delta}{2} = (250)(.04553) = 11.382$

7. $M = R\,\mathrm{Vers} \frac{\Delta}{2} = (250)(.04628) = 11.570$

8. $Lc = 2R \sin \frac{\Delta}{2} = (500)(.30071) = 150.355$

$$d_{100} = \frac{\Delta}{2} \div L = \frac{17°30'}{152.7144} = 11.45932$$

$$d_1 = .1145932$$

$$d_{25} = (.1145932)(25) = 2.8647 = 2°51.9'$$

$$d_{.7144} = (.1145932)(2.7144) = 0.31104 = 0°-18.7'$$

$$C_{25} = 2R \sin d_{25} = (500)(.04998) = 24.99$$

$$C_{.7144} = 2R \sin d_{.7144} = (500)(.00544) = 2.715$$

Station	Chord in feet	Deflection ∠ in degrees	Deflection ∠ in degrees & minutes
PC. 9+00	—	0.000	0°-0'
9+25	24.99	2.8647	2°-52'
9+50	24.99	5.7294	5°-44'
9+75	24.99	8.5941	8°-36'
10+00	24.99	11.4588	11°-28'
10+25	24.99	14.3235	14°-19'
10+50	24.99	17.1882	17°-11'
10+52.72	2.72	17.4992	17°-30'

B-52

COMPUTATION SHEET
SCS-522 REV 5-58

II

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

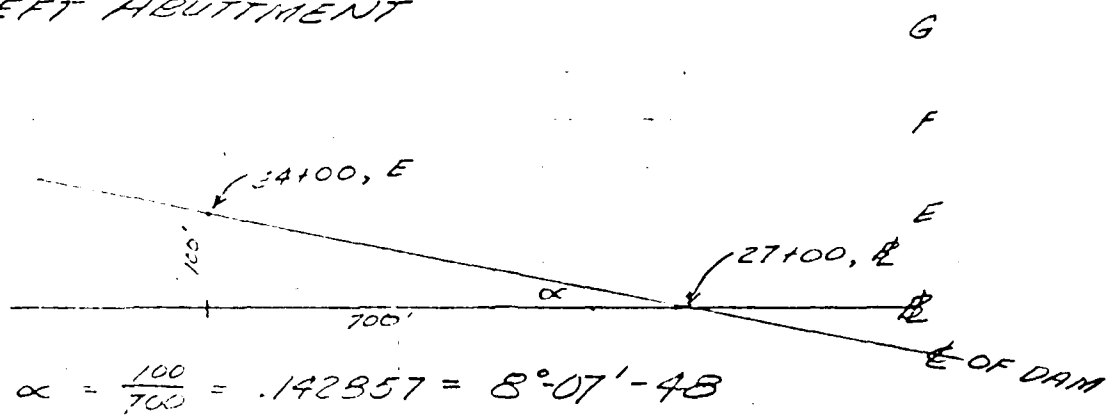
GPO 1958 O-470868

STATE	PROJECT			
NEW HAMPSHIRE	LEAD RIVER WATERSHED			
BY	DATE	CHECKED BY	DATE	JOB NO
DHT	9/16/68			NH-770-P

SUBJECT: Angle between Dam ℄ & ℄

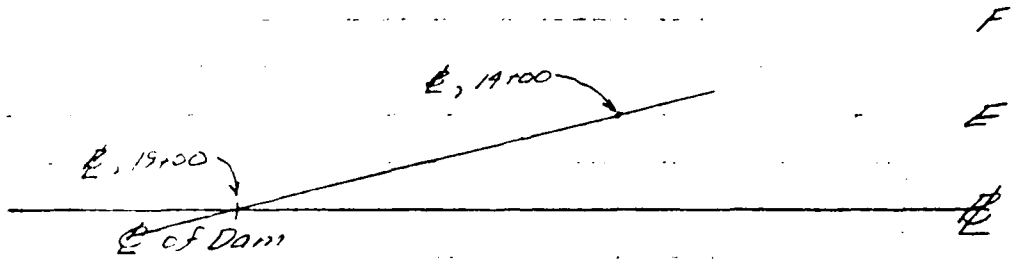
SHEET 1 OF

I LEFT ABUTTMENT



$$\tan \alpha = \frac{100}{700} = .142857 = 8°-07'-48$$

II RIGHT ABUTTMENT



$$\tan \theta = \frac{100}{500} = .20000 = 11°-18'-36''$$

-5-

C 48	3.48	—
5	5	—
	[illegible]	[illegible] DATA
	[illegible]	—
[illegible]	[illegible]	—
(SINGLE STAGE)	[illegible]	—
[illegible]	[illegible]	[illegible] REFINED DATA
[illegible]	[illegible]	[illegible] CREST AT 1362
	1360	
[illegible]	[illegible] 20,000	[illegible] DIKE EARLY
[illegible]	[illegible]	[illegible] ECONOMIC INCREASE
[illegible]	40.0	—
1364.0	1360.0	SEE ECONOMIC DATA
360	340	" " "
VEGETATED	VEGETATED	—
[illegible]	41	—
68	68	—
8.3	8.3	—
4.4)	4.4	—
(RUNOFF STORED)	[illegible]	SEE ECONOMIC DATA
" "	340	" " "
1364.0	[illegible]	" " "
20.3	20.3	—
15.57	15.57	—
10.3	11.6	—
12,110	12,175	—
1362.5	1370.9	—
—	[illegible]	—
270	68	—
—	[illegible]	—
—	[illegible]	—
—	42"	—
[illegible]	[illegible]	—
[illegible]	[illegible]	—
	[illegible]	—
C	C	—
[illegible]	—	—
—	—	—

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
NH	Dead River WS. Site 1		
BY HSS DATE 12/15/67	CHECKED BY	DATE	JOB NO NH 770
SUBJECT			SHEET 4 OF

General Considerations:

Drilling & Geologic Investigations have shown more extensive bedrock in the Emergency Spillway sites than was anticipated at the time the Watershed Work plan was prepared.

This finding dictates the Emergency spillway be raised & narrowed to reduce costly rock excavation. Studies were made to obtain optimum costs between rock excavations and extra fill caused by increased fill heights.

The studies showed the most economical combination to be: the alignment selected with a crest elevation of 1362.0 and an emergency spillway width of approx. 100 feet.

In the Watershed Work Plan the principal spillway was planned using a 1 stage inlet. In this design a two stage inlet was used for the following reasons:

A. TRASH PROBLEM

1. The flood pool is very wooded and is expected to produce much trash.
2. Beavers inhabit the general site area and are usually attracted to PL 566 impoundments. They can be expected to make attempts at modifying water levels.
3. The two stage inlet allows use of the modified grating type trash rack at the low stage particularly when beavers drop trees into the riser. When the beavers are not active, the gratings are to be removed.
4. The two stage trash rack gives more trash area before the principal spillway becomes

COMPUTATION SHEET
SCS-522 REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 C 670864

STATE	PROJECT			
N.H.	Dead River W.S. Site 1			
BY	DATE	CHECKED BY	DATE	JOB NO
HSS	12/15/67			NH-770

SUBJECT

SHEET 5 OF

interval between clogging of the stages

5. The site is relatively remote during the snow season so that inspections may become limited.
6. A 2 stage inlet has desirable trash features.

B. ECONOMICS

1. The two stage alternative raises the water levels a small amount. However, the bedrock in the emergency has made raising the E.S. Crest an economical measure in any case. The increase in water level caused by the 2 stage alternative does not result in any additional cost in fill.
2. The cost of additional concrete & trash rack cost is considered worth while.

C. OTHER

1. With a 2 stage the Gate Lift will not become inundated as frequently as with a single stage
2. Class "C" Dam with recreation

C. H. Dwight

COMPUTATION SHEET
SCS-522 REV 5-58

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE [illegible] PROJECT [illegible] W/S SITE 1

BY [illegible] DATE 9-15-67 CHECKED BY D KOOTES DATE 10-18-67 JOB NO

SUBJECT STRUCTURE CLASSIFICATION SHEET 6 OF

AS PER ESNE-73 & EM 27

MAX. HEIGHT OF DAM 38.5 FT.

ELEV. TOP OF DAM 1366.5

STORAGE BELOW TOP OF DAM (FROM PROJECTED STAGE-STORAGE CURVE = 3750 AC-FT (EST)

K_s

$\frac{(38.5)(3750)}{1000} = \frac{144.38}{90} \rightarrow K_s = 25$

K_p

FLOOD AREA, CITY OF BERLIN 250 PEOPLE (EST.) $\rightarrow K_p = 20$

K_w

EST. AVE. FLOOD PLAIN WIDTH = 300 FT $\rightarrow K_w = 5$

K_d

DISTANCE FROM STRUCTURE TO DAMAGE CENTER = 3.2 MILES $\rightarrow K_d = 1.0$

$K = \frac{K_s + K_p + K_w}{K_d} = \frac{25+20+5}{1.0} = 50$ 7-30

∴ CLASS C STRUCT.

OTHER FACTORS

FAILURE MAY CAUSE LOSS OF LIFE

COMMERCIAL & RESIDENTIAL BUILDINGS ARE IN FLOOD PLAIN

B-57

Sheet for Tabular Computations

COMPUTED [illegible] 9-15
Checked [illegible] 1/20/[illegible]

NEW HAMPSHIRE DEAD RIVER SITE 1

STAGE - STORAGE DATA

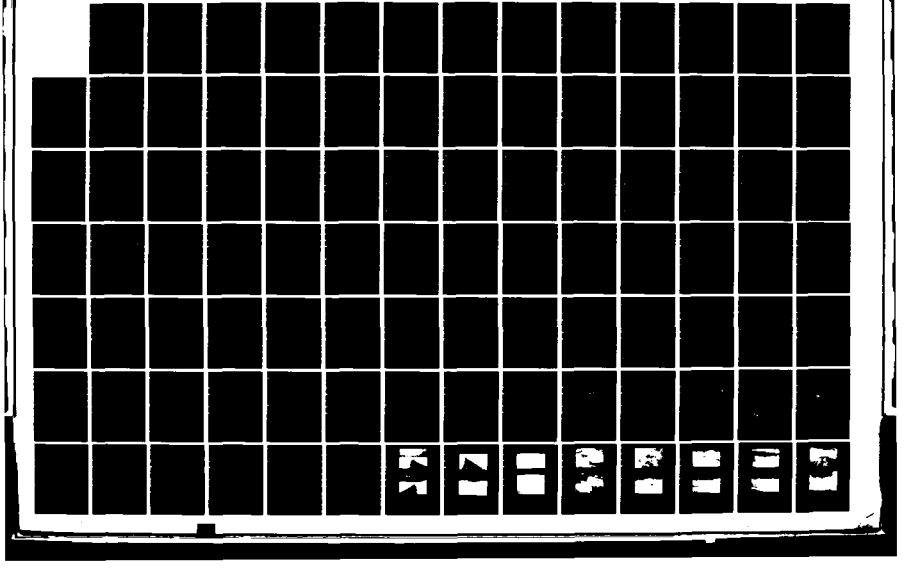
BASE ELEV. DAM HT. TOP OF DAM EL.

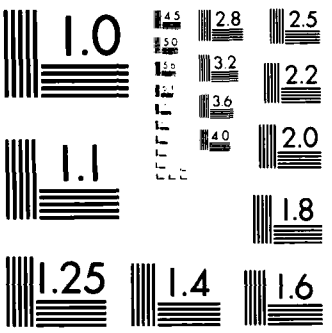
SCALE: 1" = 300 FT. 1 IN² = 2.066 ACRES

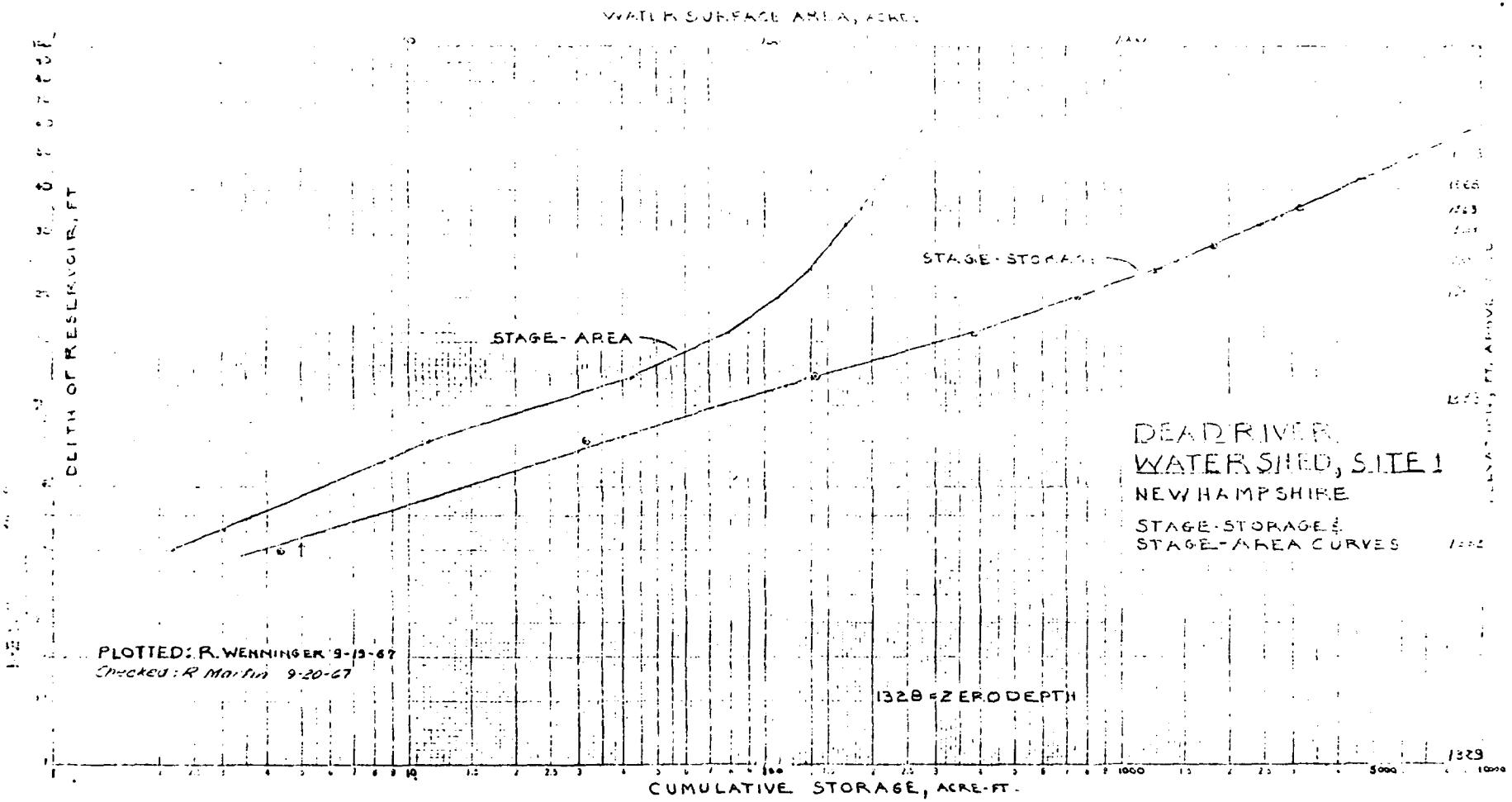
CONTOUR ELEV	INTERVAL FT	AREA IN²	AREA ACRES	Σ AREA ACRES	AVERAGE AREA ACRES	VOL. AC-FT	CUM VOL. AC-FT.	
132[illegible]		[illegible]						
	4			2.169	1.085	4.34		
1332		1.05	2.169				4.3	
	4			13.[illegible]5	6.805	27.23		
1336		5.54	11.446				31.5	
	4			53.785	26.890	107.56		
1340		20.49	42.334				139.1	
	4			121.590	60.795	243.18		
1344		[illegible]38	79.256				382.3	
	4			187.726	93.863	375.45		
1348		52.50	108.410				757.9	
	4			242.908	120.454	481.86		
1352		64.11	132.498				1239.6	
	4			284.933	142.417	569.67		
1356		73.75	153.335				1809.3	
				320.326	160.164	640.66		
1360	4	81.29	167.953				2450.0	
				354.955	177.478	709.87		
1364	4	90.50	186.982				3159.9	
				B-58				

AD-A156 748 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS SITE NUMBER 1 DEAD RI.. (U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUL 79 2/3

UNCLASSIFIED F/G 13/13 NL






WATER SURFACE AREA, ACRES
DEPTH OF RESERVOIR, FT
STAGE-STORAGE
STAGE-AREA
DEAD RIVER
WATERSHED, SITE 1
NEW HAMPSHIRE
STAGE-STORAGE &
STAGE-AREA CURVES
PLOTTED: R. WENNINGER 9-19-67
Checked: R Martin 9-20-67
1328 = ZERO DEPTH
1329
CUMULATIVE STORAGE, ACRE-FT.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-309
8-58

RESERVOIR SEDIMENTATION DESIGN SUMMARY

WATERSHED DEAD RIVER SITE NO. 1 STATE NEW HAMPSHIRE

LOCATION COOS COUNTY DATE 9-21-64

DATA COMPUTED BY E/ WILLIAM A. BONIN TITLE GEOLOGIST

COPIED BY R.M.W 9-22-67

SEDIMENT SOURCES (AVERAGE ANNUAL)

TYPE OF EROSION			PRESENT CONDITIONS ACRES	PRESENT CONDITIONS SOIL LOSS (TONS/AC)	PRESENT CONDITIONS TOTAL (TONS)	FUTURE (AFTER CONS. TREATMENT) ACRES	FUTURE (AFTER CONS. TREATMENT) SOIL LOSS (TONS/AC)	FUTURE (AFTER CONS. TREATMENT) TOTAL (TONS)
~~SHEET EROSION~~	CULTIVATED LAND	B	2792	0.039	108.9			
		C	1229	0.089	109.4	NEGLIGIBLE CHANGE		
		D	125	DEPOSITIONAL AREA				
	IDLE LAND							
	PASTURE-RANGE							
	WOODLAND							
	OTHER							

AREA OF WATERSHED: 4147 ACRES / 6.48 SQ. MI.

		DELIVERY RATE (%)		TONS DELIVERED	DELIVERY RATE (%)		TONS DELIVERED
TOTAL SHEET EROSION		20	218.3	43.7			
CHANNEL EROSION	GULLY						
	STREAMBANK						
	STREAMBED*			42.0			
FLOODPLAIN SCOUR							
OTHER (ROADSIDE ETC.)							
TOTALS				85.7			

* PROJECTED FROM THE RESULTS OBTAINED ON A SIMILAR STREAM, LANGLIN BROOK SITE, COLDR.-OLD COURSE SACO, ME. & N.H.

DEPOSITION

ESTIMATE

AVERAGE DRY WEIGHT OF UPLAND SOILS: 63 LBS/CU. FT.

TEXTURE OF SEDIMENT		
% CLAY	% SILT	% COARSE

	AVERAGE ANNUAL SEDIMENT DELIVERED TO SITE FROM ALL SOURCES (TONS)		TRAP EFFICIENCY (%)	ANNUAL DEPOSITION (TONS)	DESIGN PERIOD (YRS)	PERIOD TOTAL DEPOSITION (TONS)
~~PRESENT~~	SHEET EROSION	43.7	98	42.8	100	4280
~~FUTURE~~	BEDLOAD	42.0	100	42.0	100	4200
				DESIGN TOTALS	100	8480

SEDIMENT STORAGE REQUIREMENTS

CONDITION OF SEDIMENT	% OF TOTAL	DEPOSITION (TONS)	VOLUME WEIGHT OF SEDIMENT LBS/CU. FT.	VOLUME WEIGHT OF SEDIMENT TONS/AC. FT.	STORAGE REQUIRED ACRE-FEET	STORAGE REQUIRED WATERSHED INCHES	STORAGE ALLOCATION (ACRE FEET) SEDIMENT POOL	STORAGE ALLOCATION (ACRE FEET) RETARDING POOL	STORAGE ALLOCATION (ACRE FEET) OTHER
SUSPENDED	100	4280	60	1700	3.29		4.34		
BEDLOAD	40	3520	110	3100	1.05				
~~DEGRADED~~	10	1680	93	2630	0.76			0.70	
TOTALS		8480			5.04	0.015			

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

STATE	PROJECT		
NEW HAMPSHIRE	DEAD RIVER W/S SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
R. WENNINGER	9-20-67	D KEATES	10-18-67	

SUBJECT SOIL COVER COMPLEX CURVE NUMBER SHEET 11 OF _____

DRAINAGE AREA = 6.48 SQ MI = 4147 ACRES

SUB AREA *	LAND USE *	SOIL GROUP *	ACRES *	COMPLEX NUMBER *	COMPLEX NO. TIMES ACRES
A					
	FOREST	A-B	1425	65.5	93338
	FOREST	C-D	1180	72.9	86022
C	FOREST	A-B	830	65.5	54365
	FOREST	C-D	120	72.9	8748
E-1					
	FOREST	A-B	477	65.5	31243
	IDLE	D	115	83	9545
			4147		283261

WEIGHTED NO. = $\frac{283261}{4147}$ = 68.3

→ USE 68, AMC II
85 AMC III

* DATA TAKEN FROM,
1) FOREST SERVICE LTR TO MR. ADDISON DTD 10-30-63
2) SOIL COVER COMPLEX NO'S, PRESENT & FUTURE BY E.L.R, 7-29-64
BOTH REFERENCES IN DEAD RIVER W/S HYDROLOGY BOOK I.

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

STATE		PROJECT		
N.H.		Otis River Site 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
D.K	10-19-67	F.W.	12-8-67	

SUBJECT

SHEET 12 OF

Tc

by SS-1015

Suborea A

50% of area with these slopes

$\frac{1300}{7550} \times 100 = 17\%$

$\frac{1300}{6750} \times 100 = 19\%$

$\frac{900}{4700} \times 100 = 19\%$

$\frac{500}{3000} \times 100 = 16.7\%$

$4 \overline{)71.7}$

ave. slope = 18%

50% of area with these slopes

$\frac{200}{3000} \times 100 = 6.7\%$

$\frac{200}{2650} \times 100 = 7.5\%$

$\frac{300}{3100} \times 100 = 9.7\%$

$\frac{300}{3750} \times 100 = 8.0\%$

$4 \overline{)31.9}$

ave. slope = 8%

wgt slope

0.5 (18) = 9
0.5 (8) = 4
weighted slope = 13%

ℓ = 12250 ft.
Y = 13%
CN = 69

L = 0.95 hrs.

$T_c = 1.67 (0.95) =$ 1.6 hrs.

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O - 470868

STATE		PROJECT		
N.H.		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
D.K.	10/19/67	R.W.	12-8-67	

SUBJECT Tc

SHEET 13 OF

channelized flow through subareas B & C

Length	Fall	Slope	V.	Tc
9500'	180'	1.9%	3.1	.8 hrs.

Tc E-1 = Tc subarea A + channel Travel Time in subarea C

Tc = 1.6 + 0.8 = 2.4 hrs. AS PER WORK PLAN

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
NH	Dead River W.S. Site 1			
BY	DATE	CHECKED BY	DATE	JOB NO.
HSS	12/15/67			

SUBJECT

SHEET 14 OF

Low stage design
Designing as a 2 stage riser

As per work plan
Set permanent pool level at elevation 1352.0 (Recreation Pool).
4AC-FT. sediment considered deposited below elevation 1352.0

Ideally, release rate thru 1st stage should be as near as possible to the rate that would have been obtained using a single stage riser with the water surface at the same elevation
This cannot easily be done, therefore, proportion orifice dimensions as large as possible yet compatible with standard riser.

Set second stage elevation as close to elevation of first stage as possible & still have reasonable trash rack arrangement.

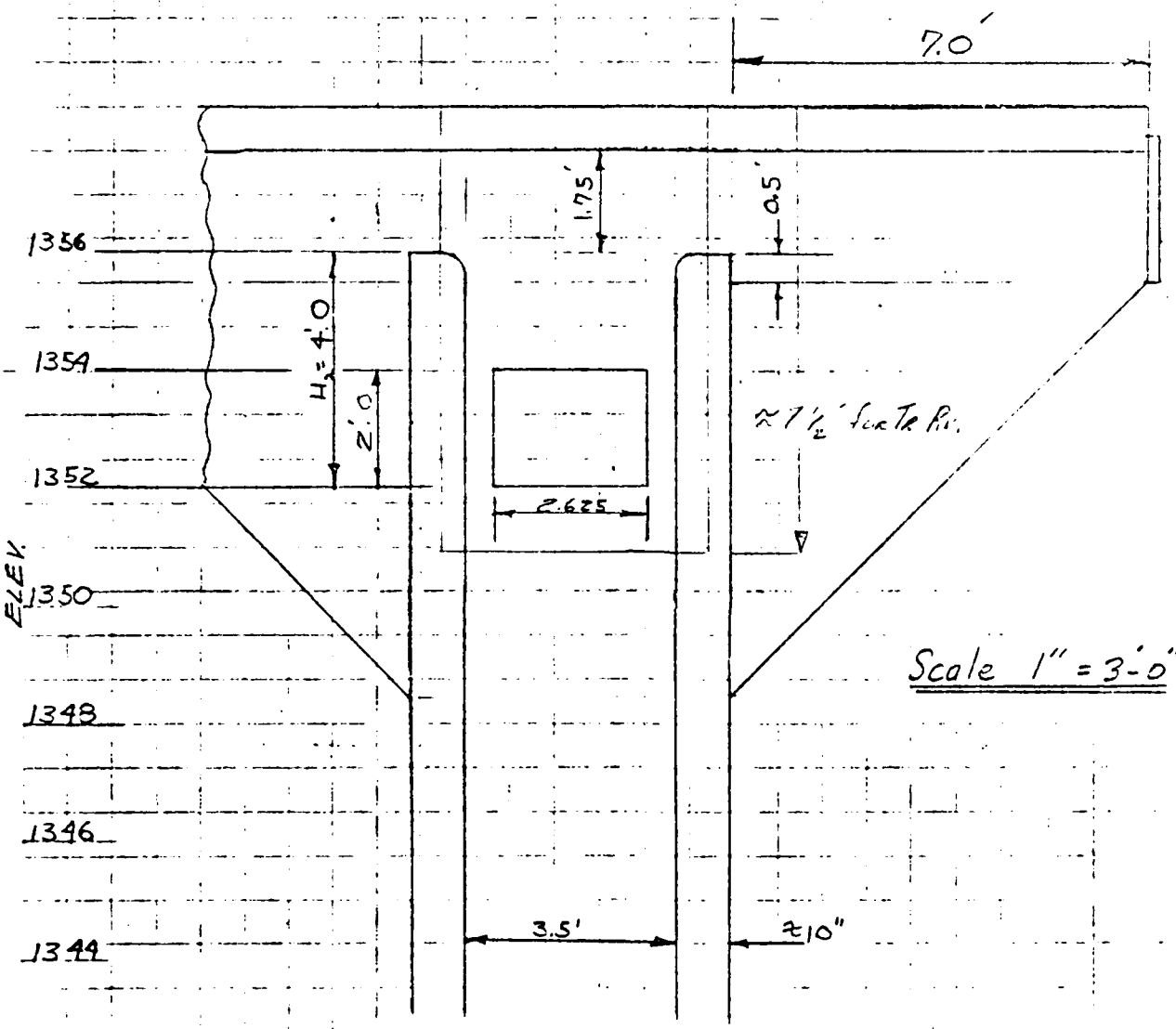
COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
NEW HAMPSHIRE	DEAD RIVER SITE 1			
BY	DATE	CHECKED BY	DATE	JOB NO
R. WENNINGER	10-2-67	D. Yeates	10-18-67	

SUBJECT COVERED TOP RISER PROPORTIONS SHEET 15 OF

Possible Relation of Sizes & Elevations Using 42" Pipe



Scale 1" = 3'-0"

By EM SCS-50
$H_2 = (2D+6")$ to 20'. for standard
on this scheme
$H_2 = 2 \times 3.5 + .5 = 7.5'$!!! 4' Provided
but still considered a good
solution for the conditions

B-65

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O-470668

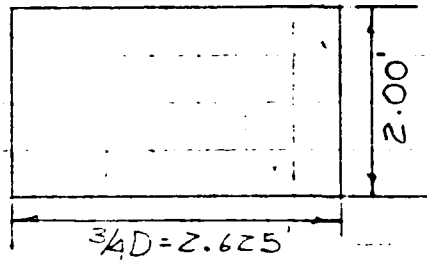
STATE		PROJECT		
N.H.		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
R WENNINGER	11-20-67	D K	11/27/67	

SUBJECT ORIFICE FLOW

SHEET 16 OF

From Sketch :

Try: Following & Second Stage crest at elev. 1356.0



USE 2 ORIFICES $C_o = .60$ SEE TR-29

$C_\ell = 3.1$ " "

LOW STAGE WEIR FLOW

$Q_{w\ell} = C_\ell \ell_\ell H_\ell^{3/2} = 3.1(2)(2.625) H_\ell^{3/2}$

$Q_{w\ell} = 16.28 H_\ell^{3/2}$

LOW STAGE ORIFICE FLOW

$Q_{o\ell} = C_o a_o \sqrt{2gh_o} = .60(2)(2)(2.625)(8.020) h_o^{1/2}$

$Q_{o\ell} = 50.53\ h_o^{1/2}$

Q when second stage begins operating

$h_o = 1356 - 1353 = 3.0$ $\quad 3^{1/2} = 1.732$

$Q_{h=1356} = 50.53 \times 1.732 = 87.52$ cfs

or $\frac{87.52}{6.48} = 13.5$ c.s.m. Reasonable

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

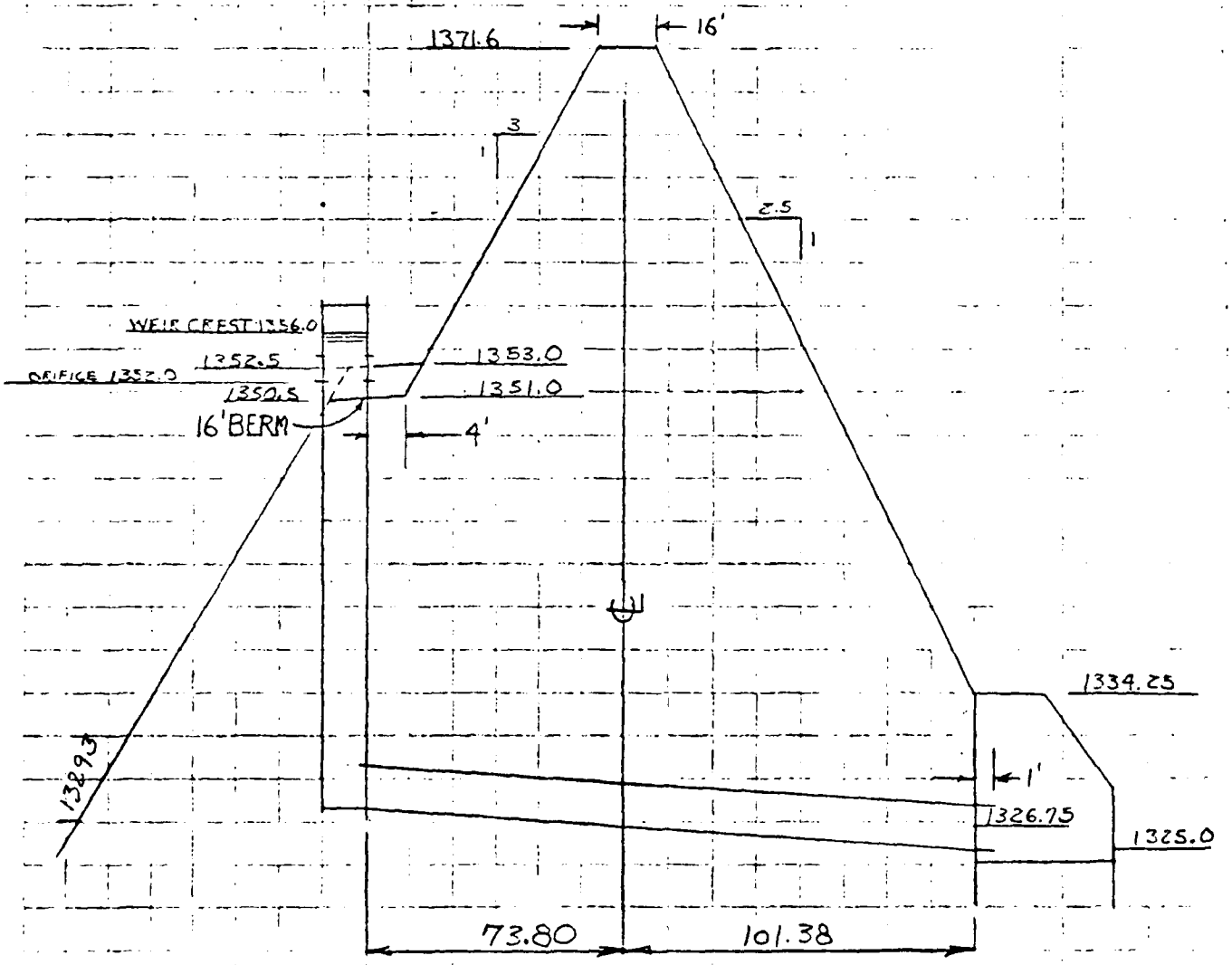
STATE	PROJECT		
NEW HAMPSHIRE	DEAD RIVER SITE 1		
BY / DATE	CHECKED BY / DATE		JOB NO.
R.WENNINGER 11-21-67			

SUBJECT

PRINCIPAL SPILLWAY DIMENSIONS

SHEET 17 OF

Assuming:



plunge pool maybe used

B-67

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
N.H		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO
R. WERNINGER	11-20-67	DK	11/27/67	

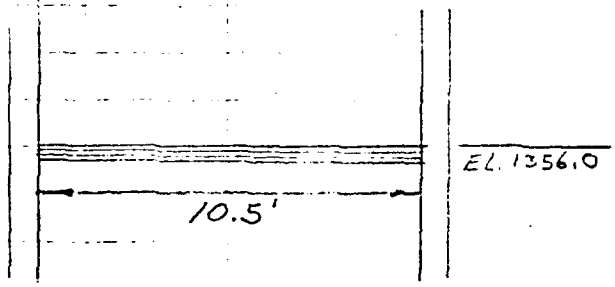
SUBJECT: RISER CREST WEIR & CONDUIT FLOW. SHEET 13 OF

WEIR FLOW

$$Q_{wh} = C_h L_h H_h^{3/2}$$

$$= 3.1(10.5)(2) H_h^{3/2}$$

$$Q_{wh} = 65.10\ H_h^{3/2}$$



CONDUIT FLOW

$$Q_{ph} = C_p h_p^{1/2}$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_e + K_p l_p}}$$

TRY 3.5' I.D. R/C

$A_p = 9.62$ ☐

$n = 0.012$

$K_e = 1.0$

$K_p = .00502$

$l_p = (1371.6 - 1351.0)3 + 16' + (1371.6 - 1334.25)2.5 + 4 + 1' = 176.18$ SAY 176'

$$C_p = 9.62 \sqrt{\frac{64.32}{1 + 1.0 + (.00502)(176)}}$$

$C_p = 45.43$

$$Q_{ph} = 45.43\ h_p^{1/2}$$

$Q_{ph\ max} = 45.43 (1362.0 - 1326.75)^{1/2} = 269.7$ CFS < 276 ☑

USE 42" PIPE

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

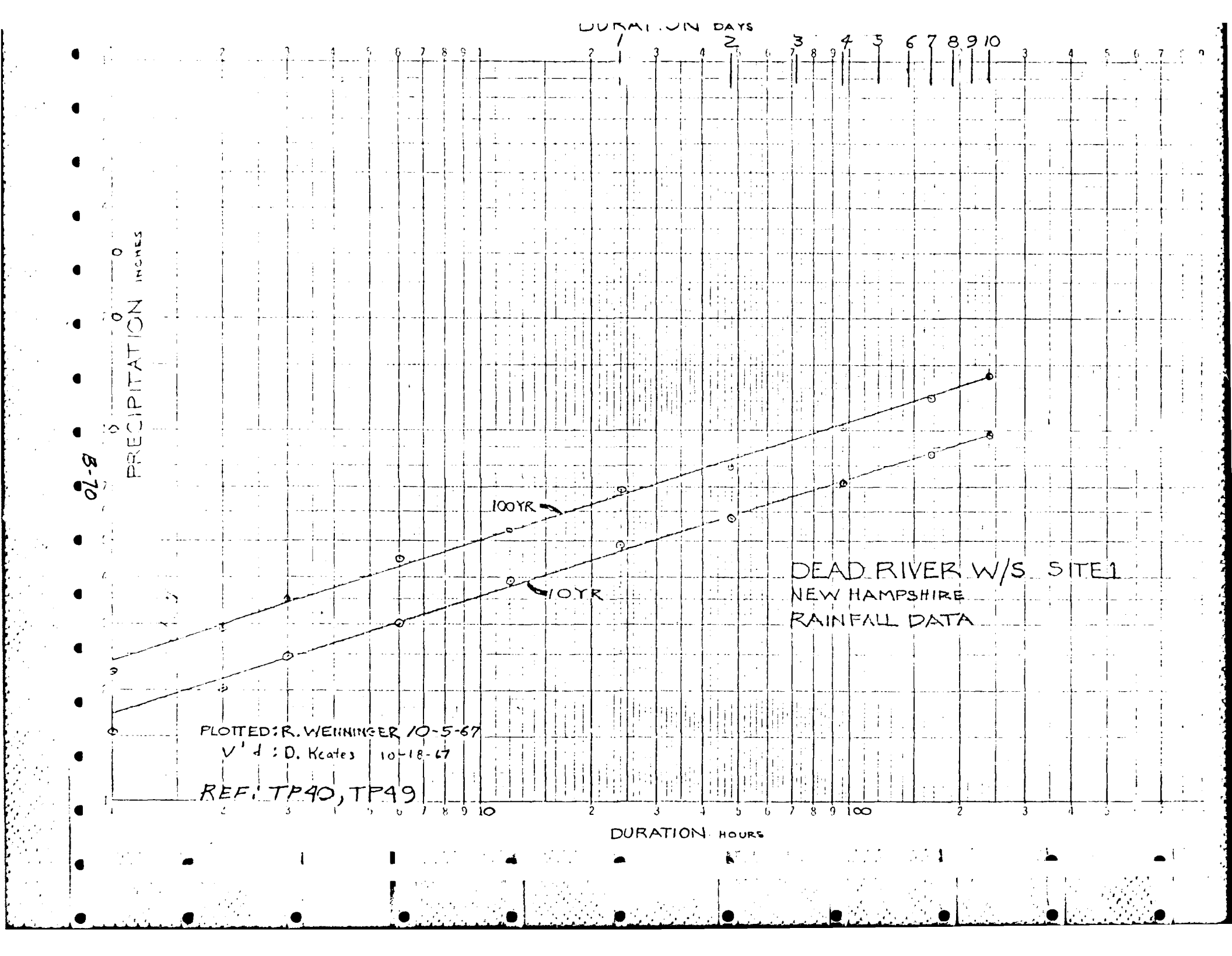
GPO 1958 O-470866

STATE	PROJECT		
NEW HAMPSHIRE	DEAD RIVER SITE 1		
BY / DATE	CHECKED BY / DATE		JOB NO.
R WENNINGER 10-5-67	D. Keates 10-18-67		

SUBJECT RAINFALL - RUNOFF RELATION — SHEET 19 OF _____

DATA TAKEN FROM TP-40, TP49, & WORK PLAN

TIME		10YR AMC II CN=68		10YR AMC II +1"/DAY SNOWMELT		10YR AMC III CN=85	100YR AMC II CN=68	
HRS	DAYS	P (INCH)	Q (INCH)	SNOWMELT (INCH)	Q (INCH)	Q (INCH)	P (INCH)	Q (INCH)
1		1.54	.07	.04	.11	.48	2.21	.26
2		2.01	.19	.08	.27	.81	2.92	.59
3		2.48	.37	.13	.50	1.16	3.50	.90
6		3.00	.63	.25	.88	1.59	4.50	1.53
12		3.90	1.14	.50	1.64	2.37	5.35	2.13
24	1	4.85	1.78	1	2.78	3.24	6.85	3.29
	2	5.80	2.47	2	4.47	4.12	8.00	4.23
	4	7.20	3.57	4	7.57	5.45	10.10	6.05
	7	8.60	4.74	7	11.74	6.80	12.10	7.84
	10	9.9	5.87	10	15.87	8.06	14.00	9.60


DURATION DAYS
1
2
3
4
5
6
7
8
9
10
PRECIPITATION INCHES
100YR
10YR
DEAD RIVER W/S SITE 1
NEW HAMPSHIRE
RAINFALL DATA
PLOTTED: R. WEHNINGER 10-5-67
V'd : D. Keates 10-18-67
REF: TP40, TP49
DURATION HOURS

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O-470868

STATE N H | PROJECT DEAD RIVER SITE 1

BY R W | DATE 12-1-67 | CHECKED BY D K | DATE 12/14/67 | JOB NO

SUBJECT Elevation of top of dam | SHEET 26 OF

FREEBOARD HYDROGRAPH ROUTING ELEVATION 1371.9

E. S. HYDROGRAPH ROUTING ELEVATION 1362.24

WAVE FREEBOARD

F = FETCH = ± 4500 FT. = ± 0.85 MILES

V = VELOCITY OF WIND = 100 MPH

H = HT OF WAVES = $0.17\sqrt{VF} + 2.50 - F^{\frac{1}{4}}$ SEELYE DESIGN 4-66

$= 0.17(9.22) + 2.50 - .96$

$H = 3.11$ FT.

$1362.24 + 3.11 = 1365.35$

FROST DEPTH

ASSUME MAX. FROST DEPTH = 5.0 FT. SEELYE DESIGN 3-32

$1362.24 + 5.0 = 1367.24$

MAXIMUM FREEBOARD ELEVATION

REQUIRED = 370.9

SET TOP OF DAM AT ELEVATION 1371.0

[illegible] 12-5-69 DES [illegible]

[illegible] 6.6

t_w - [illegible] SPILLWAY [illegible] 5.9 [illegible]

[illegible] 1569

[illegible] 1609 FT

Q_o - MAXIMUM DISCHARGE AT t_w 516 CFS

Q_p - PIPE DISCHARGE AT t_w 327 CFS

$Q_e = Q_o - Q_p$ 29 CFS

Q_I - PEAK INFLOW 476 CFS

V_I - TOTAL INFLOW VOLUME 1552 AC FT

$t_w (Q_I/V_I)\ 1/12.1 =$ 1.09

$V_{iw}/V_I =$ .984

V_{iw} - INFLOW VOLUME AT t_w 1527 AC FT

$t_r = t_w - t_e$ 1.2

$$\left[\frac{V_I - V_{iw} + (V_{sv} - V_{sv})}{Q_p + (Q_o)}\right] 12.1$$

1552 1527 1603 1560

271 3.9

3.9
~~2.4~~

4.2 [illegible]

COMPUTATION SHEET — U.S. DEPARTMENT OF AGRICULTURE

SCS-522 REV 5-58 — SOIL CONSERVATION SERVICE

STATE	PROJECT			
N.H.	DEAD RIVER SITE 1			
BY	DATE	CHECKED BY	DATE	JOB NO.
R.A.W.	12-6-67	D.K.	12/14/67	

SUBJECT: EMERGENCY SPILLWAY EXIT SLOPE & VEL. — SHEET 34 OF

CRITICAL OUTLET CHANNEL SLOPE

$b = 100$ FT., $M = 0.04$, $Q_E = 39$ CFS @ EL. 1362.24

$q_E = 0.39$ CFS/FT $q = 25\%$ OF $q_E = .0975$ CFS/FT

$$d_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{(.0975)^2}{32.2}} = .067 \text{ FT}$$ SEE ES-98

$$S_c = \frac{21.42\, n^2 (100)}{q_c^{3/9}} = \frac{21.42(.04)^2(100)}{(.0975)^{3/9}} = 5.8\%$$ SEE ES-98

$\therefore$ USE 4 % ✓ EM-27

MAX. VELOCITY THRU E.S. @ CONTROL SECTION

E.S. HYDROGRAPH

$q_E = 0.39$ CFS/FT

$d_c = .07$ FT ES-98

$V_c = 2.33$ FPS ✓ "

MAX. VELOCITY THRU E.S. @ CONTROL SECTION

FREEBOARD HYDROGRAPH

$Q_E = 7975 - 302 = 7673$ CFS

$q_E = 76.73$ CFS/FT

$d_c = 5.7$ FT ✓ ES 98

$V_c = 13.6$ FPS ✓ ES 98

SCS-319
6-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET 31

HYDROGRAPH COMPUTATION

FREEBOARD HYDROGRAPH

√d D Keates 10-12-67
R. WEHNINGER 9-20-67

WATERSHED OR PROJECT DEAD RIVER STATE NEW HAMPSHIRE

STRUCTURE SITE OR SUBAREA SITE 1

DR. AREA 6.48 SQ. MI. T_c 2.4 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 68 . STORM DISTRIB. CURVE II . HYDROGRAPH FAMILY NO. 2

STORM DURATION 6 HR. RAINFALL: POINT 20.2 IN. AREAL 20.3 IN.

Q 15.57 IN. 0.7E = COMPUTED T_p 1.68 HR. T_o 5.33 HR.

$(T_o \div T_p)$: COMPUTED ~~3.18~~ 3.17 : USED 3 . REVISED T_p 1.78 .

$q_p = \frac{484\ A}{REV.\ T_p}$ = 1762 CFS. Qq_p = 27434 CFS.

t(COLUMN) = (t/T_p) REV. T_p . q(COLUMN) = (q_c/q_p) Qq_p

DATA FROM TABLE 3.21-7 (270F52)

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	11.40	137	41		
2	0.57	82	22	11.95	82	42		
3	1.14	466	23	12.50	55	43		
4	1.71	2550	24	13.10	27	44		
5	2.28	8532	25	13.65	0	45		
6	2.84	14540	26			46		
7	3.42	16872	27	$Q = (\Delta T)(\Sigma f)$		47		
8	4.00	15774	28	645 A		48		
9	4.55	13760	29	$\Delta T = .57$		49		
10	5.13	11220	30	$\Sigma f = 115.208$		50		
11	5.70	9427	31			51		
12	6.26	7654	32	$Q = (.57)(115.208)$		52		
13	6.84	5651	33	645(6.45)		53		
14	7.40	3774	34	= 15.81		54		
15	8.00	2297	35			55		
16	8.55	1460	36	% ERROR		56		
17	9.10	870	37	$\frac{15.81 - 15.57}{15.57} \times$		57	100 = 1.5 < 5%	
18	9.66	510	38			58		
19	10.25	320	39	B-81		59		

SCS-319
6-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET 30

Emergency Spillway HYDROGRAPH COMPUTATION

D Kertes 11/13/67
R. Vienneau 10-16-67

WATERSHED OR PROJECT *Dead River* STATE *N. H.*

STRUCTURE SITE OR SUBAREA *Site 1*

DR. AREA *6.48* SQ. MI. T_c *2.4* HR. RUNOFF CONDITION NO. *II*

RUNOFF CURVE NO. *68* . STORM DISTRIB. CURVE *B* . HYDROGRAPH FAMILY NO. *3*

STORM DURATION *6* HR. RAINFALL: POINT *8.3* IN. AREAL *8.3* IN.

Q *4.49* IN. COMPUTED T_p *1.68* HR. *.7(Tc)* T_o *4.70* HR.

$(T_o + T_p)$: *4.7 / 1.68* COMPUTED *2.30* ; USED *3* . REVISED T_p *1.563*

$q_p = \frac{484\ A}{REV.\ T_p}$ = *2000* CFS. Qq_p = *8984* CFS.

t(COLUMN) = (t/T_p) REV. T_p . q (COLUMN) = $(q_c/q_p)\ Qq_p$

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	10.66	67	41		
2	0.53	36	22	11.19	18	42		
3	1.07	~~[illegible]~~ 791	23	11.72	9	43		
4	1.60	~~2590~~ 2596	24	12.25	0	44		
5	2.13	~~4290~~ 4393	25	ΔT = 0.53	Σq = 35,855	45		
6	2.66	~~48[illegible]~~ 4828	26	Q = ΔT (Σq)		46		
7	~~3.~~ 3.20	[illegible]555	27	645 A		47		
8	3.73	~~3915~~ 3998	28	Q = 0.53 (35855)		48		
9	[illegible]6	[illegible] 3459	29	645 (6.48)		49		
10	[illegible]80	[illegible] 3055	30	Q = 4.55 INCHES		50		
11	5.33	[illegible]	31			51		
12	5.86	[illegible]	32			52		
13	[illegible] 6.39	[illegible]	33	% diff	(4.55 - 4.49) / 4.49 x 100	53 = 1.34%	< 5%	
14	[illegible] .93	[illegible]	34			54		
15	[illegible] .46	[illegible]	35			55		
16	[illegible]	[illegible]	36			56		
17	[illegible] 2	[illegible]	37			57	[illegible]	
18	[illegible] 6	[illegible]	38			58		
19	[illegible] .59	[illegible]	39	B-80		59		

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Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE K. WEININGER 11-21-67
SOIL CONSERVATION SERVICE J. D. K 12-7-67
SHEET 29

NEW HAMPSHIRE DEAD RIVER SITE 1

DRAWDOWN TIME

Neglecting base flow

(1) ELEVATION	(2) FLOODWATER STORAGE AVAILABLE AC-FT	(3) INTERVAL STORAGE AC-FT	(4) DISCHARGE AT ELEVATION CFS	(5) AVERAGE DISCHARGE CFS	(6) DISCHARGE 1.98 × Col (5) AC-FT/DAY	(7) DRAWDOWN TIME DAYS	(8) ACCUMULATED TIME DAYS	
1362*	1559.4		269.7					
		350.0		265.85	526.4	.66		
1360	1209.4		262.0				.66	
		340.0		258.0	510.8	.67		
1358	869.4		254.0				1.33	
		300.7		170.75	338.1	.89		
1356	568.7		87.5				2.22	
		278.3		69.0	136.6	2.04		
1354	290.4		50.5				4.26	
		290.4		25.3	50.1	5.80		SAY 6 DAYS @ ELEV 1353.4
1352	0		0				10.06	
∴	COMMENCE FLOOD ROUTING @ ELEV 1353.4							
	*DRAWDOWN STARTED FROM E.S. CREST							

Elev	h FT	$h^{3/2}$ FT	Q_W CFS	h FT	$h^{3/2}$ FT	Q_{lo} CFS	h FT	$h^{3/2}$ FT	Q_{hw} CFS	h FT	$h^{3/2}$ FT	Q_{sp} CFS	$Q_{lo}+Q_{hw}$		
[illegible]	[illegible]	[illegible]	7.12							[illegible]	[illegible]		[illegible]		
[illegible]	0.6	[illegible]	17.57							25.85	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	11.65							[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	1.0	[illegible]	[illegible]	0	0	0 — pressure begins				[illegible]	[illegible]		[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.63?	[illegible]							31		[illegible]
[illegible]	2.0	[illegible]	45.04	1.0	[illegible]	80.52				27.75	[illegible]	[illegible]	50.53		54.5
1350.0	3.0	[illegible]	84.5?	[illegible]	1.414	71.45				28.25	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	4.0	[illegible]	[illegible]	[illegible]	1.73?	87.92	0	0	0	[illegible]	[illegible]	[illegible]			
[illegible]				3.1	1.761	88.98	[illegible]	.0316	2.06	29.35	5.418	[illegible]	[illegible]		
1356.2				3.2	1.789	[illegible]	0.2	.0894	5.82	29.45	[illegible]	[illegible]			
[illegible]				[illegible]	1.844	[illegible]	[illegible]	[illegible]	10.47	[illegible]	5.445	[illegible]	[illegible]		
[illegible]				[illegible]	1.949	98.48	0.8	[illegible]	16.58	[illegible]	5.482	[illegible]	[illegible]		[illegible]
[illegible]				4.0	2.000	101.06	1.0	1.000	35.10	[illegible]	5.505	[illegible]	[illegible]		[illegible]
[illegible]				4.75	2.179	110.10	1.75	[illegible]	150.71	31.50	[illegible]	[illegible]	[illegible]		
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31.??	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	5.19?	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]										33.??	[illegible]	[illegible]			
[illegible]										34.??	[illegible]	[illegible]			
[illegible]										35.25	[illegible]	[illegible]		[illegible]	
[illegible]										35.35	5.946	2?.13		[illegible]	[illegible]
[illegible]										35.45	5.954	[illegible]		[illegible]	
[illegible]										35.65	5.971	[illegible]		[illegible]	
[illegible]										[illegible]	6.021	[illegible]		[illegible]	[illegible]
[illegible]										37.25	6.103	[illegible]		[illegible]	[illegible]
[illegible]										38.25	6.185	[illegible]		1100	[illegible]
[illegible]										39.25	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]										41.25	6.423	[illegible]		[illegible]	[illegible]
[illegible]										43.25	6.576	[illegible]		[illegible]	[illegible]
[illegible]										[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]										44.25	6.652	[illegible]		[illegible]	[illegible]

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Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE K. WENNINGER 11-17-67
SOIL CONSERVATION SERVICE J. D. KEATES 11/27/67

SHEET 37

DEAD RIVER SITE 1

EMERGENCY SPILLWAY STAGE & DISCHARGE DATA (Cont)

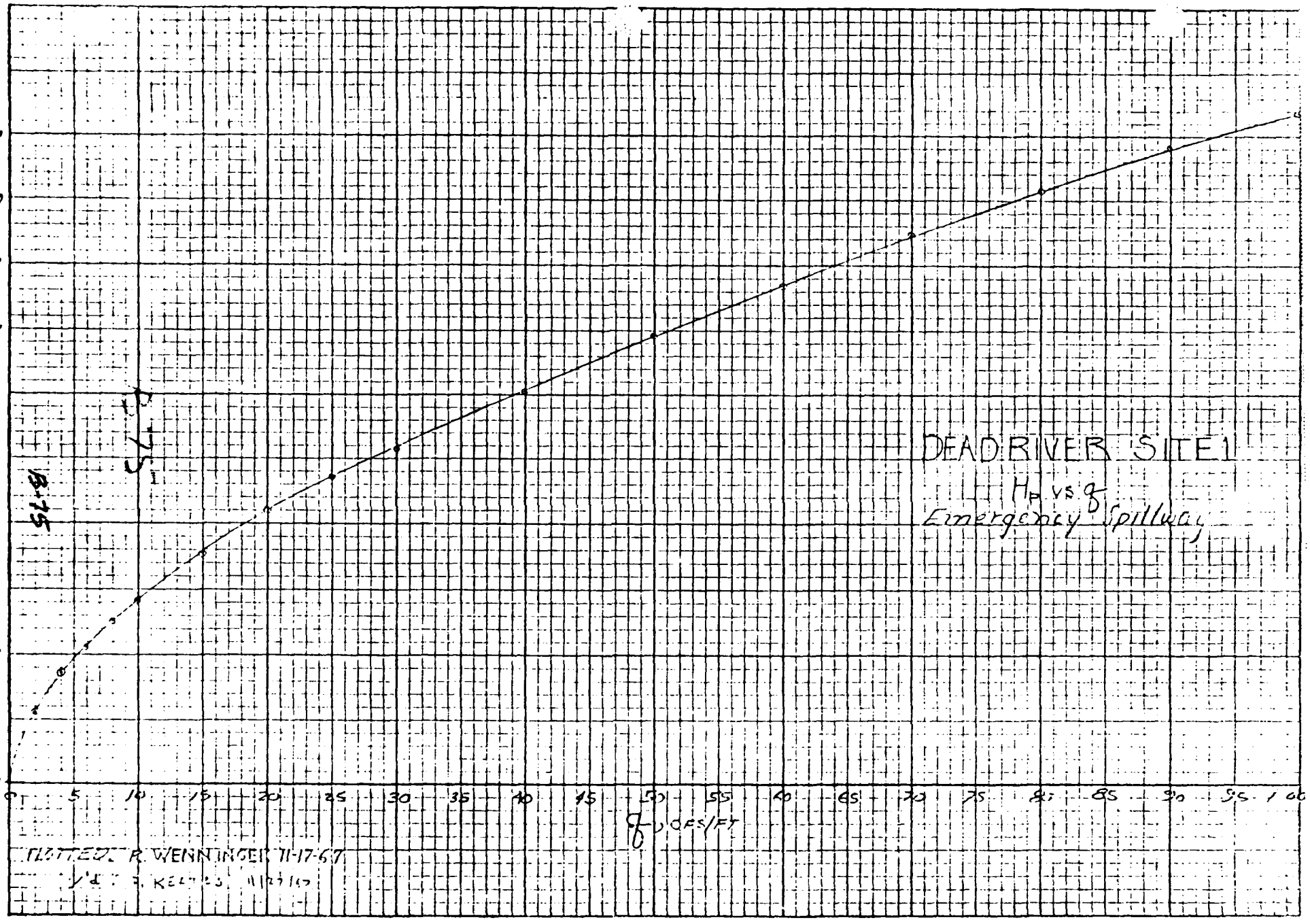
(10) $D=d_x+V^2/2g$ FT	(11) WATER SURFACE = 1354.0 + D	(12) H_p = WATER SURFACE − 1362.0	(13) q CCS/FT	(14) $q_E = q_b$ CFS	(15) ELEV. 1362.0 + H_p			
15.71	1369.71	7.71	60	6000				
		8.0	64.0	6400	1370			
16.46	1370.46	8.46	70	7000				
		9.0	78.0	7800	1371			
17.15	1371.15	9.15	80	8000				
		9.6	87	8700	1371.6			
17.82	1371.82	9.82	90	9000				
		10.0	93.4	9340	1372			
18.38	1372.38	10.38	100	10000				

DEAD RIVER SITE 1

EMERGENCY SPILLWAY STAGE & DISCHARGE DATA

REF: ES-124

(10) $D=d_x+V^2/2g$ FT	(11) WATER SURFACE = 1354.0 + D	(12) H_p = WATER SURFACE - 1362.0	(13) q cfs/ft	(14) $q_E = q_b$ cfs	(15) ELEV 1362.0 + H_p			
0		0			1362.0			
		0.1	0.10	10	1362.1			
		0.2	0.25	25	1362.2			
		0.4	0.4 0.5	40 50	1362.3 1362.4			
		0.6	0.8	80	1362.6			
		0.8	1.2	120	1362.8			
		1.0	1.7	170	1363.0			
		1.1	1.9	190	1363.1			
9.12	1363.12	1.12	2	200				
9.73	1363.73	1.73	4	400				
		2.0	5.3	530	1364.0			
10.13	1364.13	2.12	6	600				
10.52	1364.52	2.52	8	800				
10.83	1364.83	2.83	10	1000				
		3.0	11	1100	1365.0			
11.55	1365.55	3.55	15	1500				
		4.0	18.4	1840	1366.0			
12.20	1366.20	4.20	20	2000				
12.72	1366.72	4.72	25	2500				
		5.0	28.0	2800	1367.0			
13.15	1367.15	5.15	30	3000				
		6.0	39.0	3900	1368.0			
14.05	1368.05	6.05	40	4000				
14.92	1368.92	6.92	50	5000				
				B-76				


DEAD RIVER SITE 1
H_p vs. q
Emergency Spillway
H_p, FEET
q, CFS/FT
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
1
2
3
4
5
6
7
8
9
10
11
PLOTTED: R. WENNINGER 11-17-67
CHK'D: J. KELLEY 11/27/67

DEAD RIVER SITE 1

EMERGENCY SPILLWAY STAGE & DISCHARGE DATA (CONT)

(1) q CFS/FT	(2) $(l_c - l_x)$ FT	(3) ES 124 Z of 52 d_x FT	(4) $n^2(l_c - l_2)$ for d_2 = d_x ES 124 Z of 52	(5) $(l_c - l_2) =$ 625 (col 4)	(6) $(l_c - l_1) =$ $(l_c - l_2) + (l_2 - l_1) =$ 400 + Col (5)	(7) $n^2(l_c - l_1)$ = .0016 x (col 6)	(8) d_1 ES 124 6 of 52	(9) ES 139 1 of 1 $V^2/2g$
60	60	6.17	.0233	14.56	414.56	.663	15.58	.13
70	"	6.69	.0258	16.13	416.13	.666	16.30	.16
80	"	7.19	.027	16.88	416.88	.667	16.95	.20
90	"	7.62	.027	16.88	416.88	.667	17.59	.25
100	"	8.08	.0277	17.31	417.31	.668	18.13	.29

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Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET 23

DEAD RIVER SITE 1

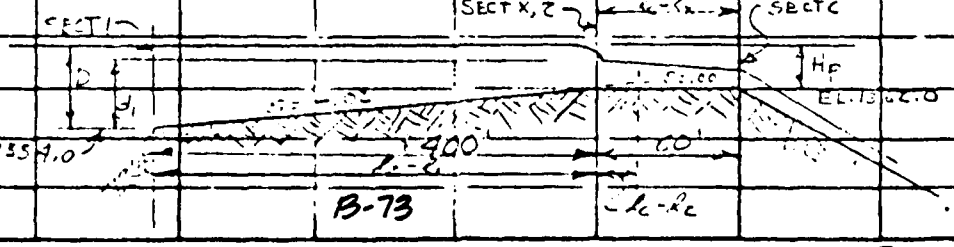
EMERGENCY SPILLWAY STAGE & DISCHARGE DATA

REF: ES-124

$b = 100$ FT. $m = 0.04$ $\frac{1}{m^2} = 625$ $n^2(l_c - l_a) = .0960$

$l_2 - l_1 \approx 400$ FT $(l_c - l_2) = 60$ FT.

(1) q CFS/FT	(2) $(l_c - l_x)\,n^2$	(3) ES 124 2 OF 52 d_x FT	(4) $n^2(l_c - l_2)$ For d_2 = d_x ES 124 6 OF 52	(5) $(l_c - l_2) = 625$ (col 4)	(6) $(l_c - l_1) = (l_c - l_2) + (l_2 - l_1) = 400 +$ (col 5)	(7) $n^2(l_c - l_1) = .0016 \times$ (col 6)	(8) d_1 ES 124 6 OF 52	(9) ES 139 1 OF 1 $V^2/2g$ FT
0	.0960	0						
2	"	1.02	.018	11.25	411.25	.658	9.12	< .1
4	"	1.46	.022	13.75	413.75	.662	9.73	< .1
6	"	1.78	.023	14.38	414.38	.663	10.13	< .1
8	"	2.08	.025	15.63	415.63	.665	10.52	< .1
10	"	2.32	.0255	15.94	415.94	.6655	10.83	< .1
15	"	2.87	.026	16.25	416.25	.666	11.55	< .1
20	"	3.31	.0225	14.06	414.06	.6625	12.20	< .1
25	"	3.73	.023	14.38	414.38	.663	12.72	< .1
30	"	4.12	.024	15.00	415.00	.664	13.15	< .1
40	"	4.86	.026	16.25	416.25	.666	14.05	< .1
							13.7	
50	"	5.54	.0215	13.44	413.44	.6615	14.81	0.11



COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O-470868

STATE		PROJECT		
N H		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
C M W	12-7-67	D. K.	12 | 14 | 67	

SUBJECT
ELEVATION OF EMERGENCY SPILLWAY CREST

SHEET 22 OF

REQUIRED STORAGE:

Q = 4.10 INCHES — WORK PLAN

$Q = \frac{4.10 \times 4147}{12} = 1416.9$ AC-FT

TOTAL SEDIMENT = 5 AC-FT

RECREATION = 1235.6 AC-FT

1240.6

TOTAL NECESSARY STORAGE TO E.S CREST = 2657.5 A.F

FROM STAGE-STORAGE CURVE:

2657.5 AC-FT → EL. 1361.25

FROM ECONOMIC DATA, USE EL. 1362.0

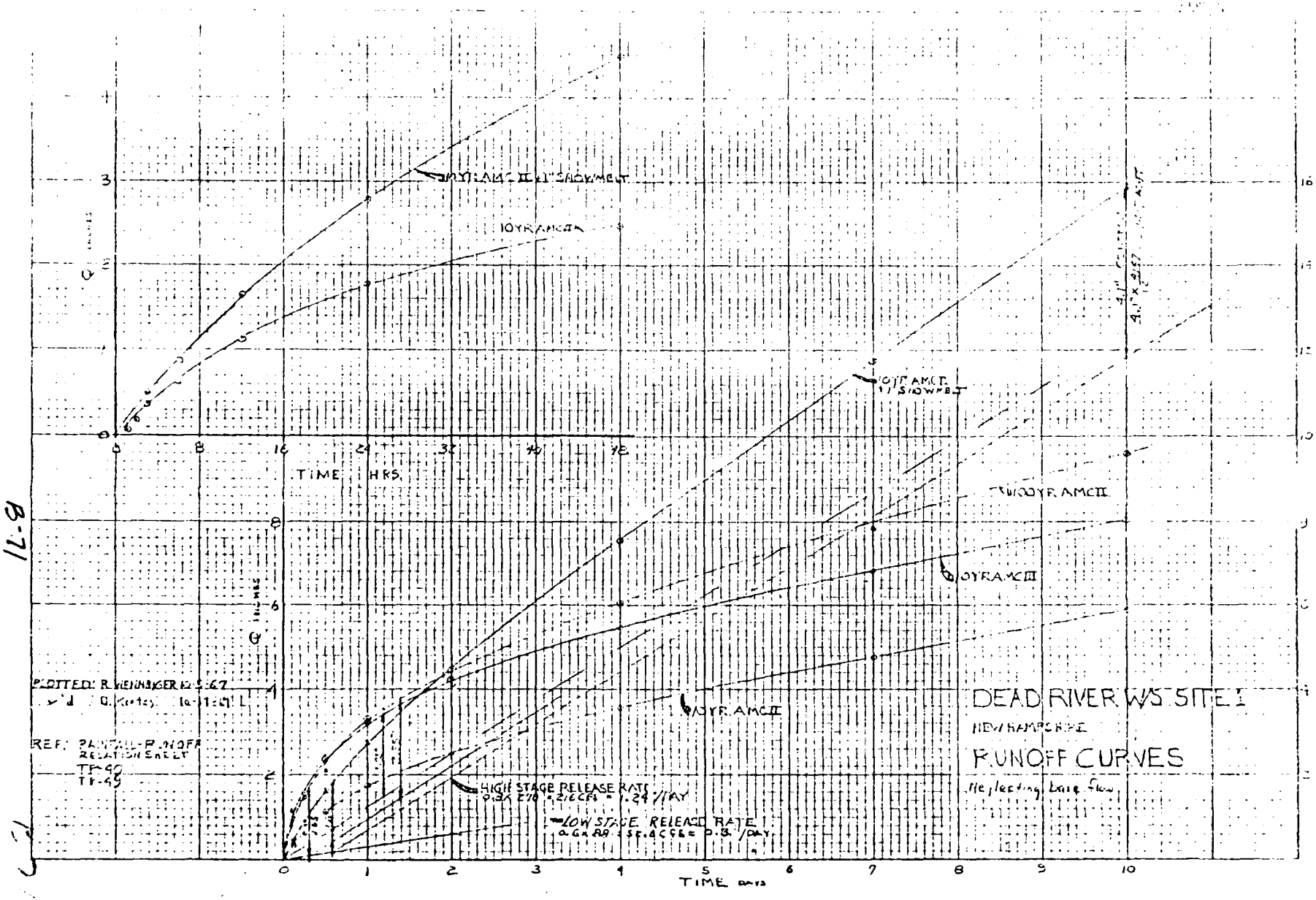
Storage to elev. 1362.0 = 2800 A.F

− 1240.6

1559.4

or $\frac{1559.4}{4147} \times 12 = 4.51''$ > 4.10" O.K.

(PROVIDED) (NEEDED)


100 YR AMC II + 1" SNOWMELT
100 YR AMC II
100 YR AMC II + 1" SNOWMELT
100 YR AMC II
50 YR AMC II
10 YR AMC III
TIME HRS.
TIME hrs
HIGH STAGE RELEASE RATE
0.3 X 2.70 = 2.16 CFS = 1.29 "/HR
LOW STAGE RELEASE RATE
0.6 X 88 = 52.8 CFS = 0.8 "/HR
PLOTTED: R. WEINBERGER 12-5-67
REF: RAINFALL-RUNOFF RELATION SHEET TP-48 TP-49
DEAD RIVER WS SITE 1
NEW HAMPSHIRE
RUNOFF CURVES
Neglecting Base Flow

12-8

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
NH	Dead R. Site 1			
BY: HSS	DATE: 6/13/68	CHECKED BY: RW	DATE: 8-68	JOB NO

SUBJECT: Reservoir Drain Pipe Size — SHEET ___ OF ___

Ave. annual runoff ≈ 22 inches

or $\frac{22}{365} = 0.0603$ inches/day

or $\frac{0.0603}{0.03719} = 1.62$ c.s.m.

or $1.62 \times 6.48 = 10.5$ cfs (ave rate of runoff

Try 30" RCP reservoir drain $S = 0.005$

$a_{30} = 4.909$ Ft.^{2}

From "Design" Seelye

$Q = 25$ cfs (water level with top of entrance

$25 > 10.5$ cfs O.K.

using 24" RCP $Q = 14 > 10.5$ Also O.K.

Estimate time to empty reservoir

$S = 1236$ A.F. (Beneficial Stor.) + 5 (Sed. Stor.) = 1241 AF

Using 30" RCP & $Q_{MAX.} = .62\, a \sqrt{2gh}$

$h = 1352 - \left(1329.5 + \frac{2.5}{2}\right) = 21.25'$

$Q_{MAX.} = .62 \times 4.909 \times 8.02 \times \sqrt{21.25}$ (4.61)

$= 112.3$ cfs

$Q_{ave.} = (112.3 + 25)\frac{1}{2} = 68.7$ cfs

$Q_{net} = 68.7 - 10.5 = 58.2$ 1 cfs = 1.98 AF/D.

T = time to empty $= \frac{1241}{58.2 \times 1.98} = \underline{10.8 \text{ Days}}$ O.K.

T with 24" Pipe = 20.1 Day (Excessive)

∴ Use 30" RCP Reservoir Drain

Q Max. = 112.3 (30")

$\frac{112.3}{6.48} = 17.3$ csm B-85

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470888

STATE		PROJECT		
N.H.		Dead R. Site 1		
BY	DATE	CHECKED BY	DATE	JOB NO
HSS	6/12/68	RW	6-24-68	NH 770

SUBJECT
Tailwater in Outlet Channel

SHEET ____ OF ____

$Q_{max.} = 270$ cfs

$n = 0.035$

$b = 16'$

$s = 0.005$

$z = 2$

$\frac{Q}{b} = \frac{270}{16} = 16.9$ cfs/ft.

$\frac{z}{b} = \frac{2}{16} = 0.125$

From ES-24 1 of 3

$d_c = 1.9'$

$$\frac{nQ}{b^{8/3} S_o^{1/2}} = \frac{.035 \times 270}{16^{8/3} \times .005^{1/2}} = \frac{9.45}{1630 \times .07071} = .082$$

115.2573

$z = 2$

From ES-55 2 of 4

$\frac{d}{b} = 0.165$ $\therefore$ $d = .165 \times 16 = 2.64'$

$A = d(b + zd) = 2.64(16 + 2.64 \times 2)$
$= 56.4$ Ft^2

$V = \frac{Q}{A} = \frac{270}{56.4} = 4.8$ fps. O.K.

P. 36

When $Q = 270$ cfs & Channel inv @ 1320.5
Elev of W.S. = 1323.14
Set top of Rip Rap @ El 1323.5

B-86

SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470668

STATE		PROJECT		
NH		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
RW	8-68			NH-770-H

SUBJECT FLOODWAY - ELEV. TOP OF DAM SHEET ____ OF ____

THE RIGHT SIDE (LOOKING DOWNSTREAM) OF THE DAM MUST BE RAISED ABOVE THE ELEVATION NORMALLY REQUIRED, TO PROVIDE FREEBOARD FOR THE FLOODWAY FLOW.

THE TOP ELEVATIONS OF THE DAM ADJACENT TO THE FLOODWAY WILL BE DETERMINED BY CONSIDERING THE FOLLOWING:

1. THAT ALL THE JERICHO BROOK FLOW ENTERS THE FLOOD POOL THRU THE FLOOD-WAY & DIVERSION CHANNEL.

2. THAT THE PEAK FREEBOARD FLOW PASS THE FLOODWAY WITHOUT OVERTOPPING THE DAM.

PEAK INFLOW = (16872)(5.66/6.48)* = 14745
POOL ELEV. @ PEAK FLOW = 1363.8*

3. THAT THE FLOODWAY FLOW, WHEN THE POOL ELEV. IS MAXIMUM, PASS WITHOUT OVERTOPPING THE DAM

MAX. POOL ELEV. = 1370.9
FLOW IN BROOK WHEN POOL ELEV EQUALS 1370.9 IS (7975)(5.66/6.48)
= 6966 CFS

4. THAT AN ARBITARY FLOODWAY FLOW (VALUE BETWEEN THOSE IN PARA. 2 & 3 ABOVE) PASS WITHOUT OVERTOPPING THE DAM

SAY FLOW = 13280 CFS
POOL ELEV @ 13280 = 1367.0

B-87

* SEE FREEBOARD ROUTING - BROOK DRAINAGE AREA

STATE		PROJECT		
NEW HAMPSHIRE		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
RW	8-68			NH-770-H

SUBJECT

n-FLOODWAY

SHEET ____ OF ____

SELECTION OF n

Σ STA 22+00 TO 17+00

STEP 1	0.025	CHANNEL IN ROCK & EARTH
STEP 2	0.015	IRREGULARITY
STEP 3	0.010	SIZE & SHAPE
STEP 4	0.020	OBSTRUCTIONS
STEP 5	0.007	VEGEATATION
STEP 6	0.000	DEGREE OF MEANDERING
TOTAL	0.077	

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O-470886

STATE		PROJECT		
NEW HAMPSHIRE		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
R.W.	2-1-68	HSS	2/26/68	NH-770-H

SUBJECT n - FLOOD WAY

SHEET 1 OF —

SELECTION OF n — NEH, SEC 5, SUP. B 19:

Σ STA 17+00 TO 9+00

STEP 1	0.025	CHANNEL IN ROCK & EARTH
STEP 2	0.010	MODERATE DEGREE OF IRREGULARITY
STEP 3	0.010	VARIATION IN SIZE & SHAPE LARGE & SMALL SECTIONS ALTERNATING, SHAPE CHANGES.
STEP 4	0.008	MINOR EFFECT OF OBSTRUCTIONS
STEP 5	0.007	LOW DEGREE OF EFFECT CAUSED BY VEGETATION
STEP 6	0.000	DEGREE OF MEANDERING
TOTAL	0.060	

n = .060

THIS VALUE BASED ON FOLLOWING:
FLOODWAY CLEARED & GRUBBED
PLANED & SEEDED
DAM PARTLY RIPRAPPED

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O-470868

STATE		PROJECT		
NEW HAMPSHIRE		DEAD RIVER SITE 1		
BY	DATE	CHECKED BY	DATE	JOB NO.
R.W.	2-16-68	HSS	2/26/68	NH-770-H

SUBJECT n - FLOODWAY SHEET ____ OF ____

SELECTION OF n

FROM STA 9+00 TO END OF STUDY (≈ 5+00)

STEP 1	CHANNEL IN EARTH & ROCK	0.025
STEP 2	MODERATE DEGREE OF IRREGULARITY	0.015
STEP 3	VARIATION IN SIZE & SHAPE, LARGE & SMALL SECTIONS ALTERNATING SHAPE CHANGES	0.010
STEP 4	APPRECIABLE EFFECT OF OBSTRUCTIONS	0.030
STEP 5	VERY HIGH EFFECT CAUSED BY VEGETATION	0.070
STEP 6	DEGREE OF MEANDERING	0.000
TOTAL		0.15

L-90

B-90

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

LAB REPORT

UNITED STATES GOVERNMENT

Memorandum

TO : C. H. Dingle, State Conservation Engineer, SCS, Durham, New Hampshire

DATE: April 22, 1968

FROM : Lorn P. Dunnigan, Head, Soil Mechanics Laboratory, SCS, Lincoln, Nebraska

SUBJECT: ENG 22-5, New Hampshire WP-08, Dead River, Site No. 1 (Coos County)

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 4 sheets.
2. Form SCS-355, Triaxial Shear Test Data, 3 sheets.
3. Form SCS-352, Compaction and Penetration Resistance Report, 5 sheets.
4. Form SCS-353, Soil Classification, 1 sheet.
5. Form SCS-130, Drain Materials, 1 sheet.

DISCUSSION

FOUNDATION

A. Bedrock: Bedrock underlies the till on the abutments and the alluvium in the floodplain at depths of from 0 to 27 feet. The bedrock is described in the geology report for this site.

Durability tests were made on the rock cores from test hole 505. During the Los Angeles abrasion test the loss was 45.8 percent. Gradation A (Federal specification) was used for the test. The ledge rock procedure was used for the soundness test and the loss during 5 cycles was only 0.09 percent.

B. Soil Classification: The soil on the abutments is primarily glacial till. Sample 4.1 and 214.1 are considered to be representative of the majority of the till on the left abutment. The grain-size curve for these two samples and curves for two other samples from the spillway are shown on the attached form SCS-353 for comparison. The gradation of these four samples fall within a relatively narrow range and the properties of the materials are expected to be comparable. The till on this abutment is stratified in some zones as indicated by variable and high permeability rates and by sample 503.2 which represents a water worked till from the 11 to 14-foot depth. Sample 4.1 contains 15 percent fines and is classified as non-plastic SM. Sample 214.1 contains 10 percent fines and is an SM-SP. The water worked till contains 28 percent fines and is classified as non-plastic SM. There is some muck and alluvium in the vicinity of centerline station 34+00 on this abutment.

The mantle material in the floodplain between approximate centerline stations 21+50 and 27+50 consist of a surface zone of muck overlying pervious alluvium that is logged primarily as SP and SP-SM. Sample 502.1 was submitted from approximately the toe area downstream from centerline station 24+50. The material represented contains 13 percent fines and is classed as non-plastic SM.

The muck averages about 1.5 feet thick and ranges up to 6.5 feet thick. The sandy alluvium ranges from 0 to about 20 feet thick.

The till on the right abutment and diversion area ranges from about 30 feet at approximately centerline station 20+00 to from 0 to about 5 feet on the rest of the abutment right of centerline station 19+00. Samples were submitted from test holes 7 and 10 on the abutment. These samples are somewhat finer grained than the till on the left abutment. They contain about 30 percent fines and they are classed as non-plastic SM and low plasticity SC-SM.

C. Shear Strength: The blow count in the till and the alluvium is relatively high and, based on this data, it appears that the shear strength of the till and the alluvium is adequate for the embankment planned. It is planned to strip the muck from the foundation and its shear strength will not be a problem.

D. Consolidation: With the muck removed the consolidation potential of the till and of the alluvium is expected to be very low.

E. Permeability: The permeability of the till and of the alluvium is expected to be highly variable. Field permeability tests were made and the data are reported in the geology report.

EMBANKMENT

A. Classification: The majority of the fill material at this site is represented by samples 4.1, 59.1, 207.1, 214.1 and 221.1. The gradation curves for each of these samples falls within a relatively narrow range as shown on the attached form SCS-353. Sample 4.1 contains 14 percent fines and is classed as a non-plastic SM. The other four samples referred to above contain from 8 percent to 11 percent fines and they are classed as SP-SM.

The bulk dry density of the gravel fire material is in excess of 160 pcf.

B. Compacted Density: Standard Proctor compaction tests were made on the minus No. 4 fraction of samples 207.1, 214.1, 221.1, 4.1 and 7.1. The maximum dry densities obtained fell within a relatively narrow range of from 120 pcf to 124 pcf.

In addition to the standard compaction tests a relative density test was made on the minus 1 1/2-inch fraction of sample 214.1. The test was made in accordance with ASTM designation D2049. The minimum density obtained is 115 pcf and the maximum density obtained is 139.1 pcf.

C. Permeability: Permeability consolidation tests were made on the minus No. 4 fraction of sample 214.1 (68W1663). The tests were made at densities of 95 percent of Proctor and at 100 percent of Proctor.

The test data obtained are summarized as follows:

Test γd		k in fpd			Consolidation ft/ft		
pcf	% Proctor	2000 psf	4000 psf	8000 psf	2000 psf	4000 psf	8000 psf
114.5	945	3.000	5.000	7.000	0.004	0.008	0.014
120.9	100	0.055	0.038	0.035	0.012	0.017	0.020

The test data for the test at 95 percent of Proctor is not conclusive. You will note that the permeability rate increased as the load was increased and that the consolidation potential was less under these loadings than it was at 100 percent of Proctor. We don't know the reason for this apparent discrepancy but we will set up a check test and report the data when the test is complete.

D. Shear Strength: Consolidated undrained triaxial shear tests were made on sample 214.1 (68W1663). One test was made on the minus No. 4 material compacted to 95 percent of standard Proctor density and one test was made on the material finer than one inch compacted a density of approximately 128 pcf. The test specimens for the minus one inch material were graded so that they contained 40 percent gravel. The test specimen diameter was 4.0 inches.

The test data are summarized as follows:

Sample No.	% Gravel in Test Specimen	Test Specimen Diameter (Inches)	Test Density (pcf)	Degree of Saturation	Shear Strength Parameters			
					Total Stress		Effctv. Stress	
					∅ deg	c psf	$\bar{\emptyset}$ deg	$\bar{c}$ psf
68W1663	0	1.4	114	76.3	42.0	0	--	--
68W1663	40	4.0	128	80.9	43.5	0	43.5	0

You will note that the degree of saturation is low for both tests. The 1.4 inch diameter test specimens were soaked prior to testing and the 4.0 inch specimens were molded at saturation. The computations for the degree of saturation are based on the moisture content after test and weight loss during the test. The material tested contains a relatively low percentage of non-plastic fines and the specimens drain very rapidly. This is believed to be the reason for the low degree of saturation. The test results have been interpreted as c = 0 and this was done to make allowance for the low degree of saturation.

The test density used for the specimens containing gravel is equal to 95 percent of the minus No. 4 Proctor density adjusted for 40 percent gravel. It is interesting to note that this density is within 3 pcf of 70 percent of relative density on the minus 1 1/2-inch fraction.

E. Durability of Rock: The Los Angeles abrasion test and the sodium sulfate soundness tests were made on five samples. The test data obtained are summarized as follows:

Sample Number			Los Angeles Abrasion		Sodium Sulfate Soundness	
Field	Laboratory		Gradation	% Wear	Procedure	% Loss
18	1666		G	37.5	Ledge Rock	0.1
227	1667		G	62.5	Ledge Rock	0.2
230	1670		G	55.1	Ledge Rock	0.08
505	1671		A	45.8	Ledge Rock	0.09
4.1 59.1	1653 1659 1658	Mix	A	45.9	Coarse Aggregate	2.73

It was noted that thin sections of 68w1668 (Field No. 228) could be flaked with the fingers, therefore, no tests were made.

The gradation referred to in the table under Los Angeles Abrasion corresponds to grading in the Federal specification for this test.

SLOPE STABILITY

The stability of the proposed 3:1 upstream slope and the 2 1/2:1 downstream slope was checked with an infinite slope method of analysis. The analyses is summarized as follows:

5 -- C. H. Dingle -- 4/22/68
Lorn P. Dunnigan
Subj: ENG 22-5, New Hampshire WP-08, Dead River, Site No. 1

Slope	Condition	γ Sat. pcf	Shear Parameters		Fs
			Ø deg	c psf	
3:1 Upstream	Horizontal flow lines	128.5	42°	0	1.22
3:1 Upstream	Parallel flow lines	128.5	42°	0	1.37
2 1/2:1 Downstream	No Drain - Horizontal flow lines	128.5	42°	0	0.99
2 1/2:1 Downstream	No Drain - Parallel flow lines	128.5	42°	0	1.14
3:1 Downstream	No Drain - Horizontal flow lines	128.5	42°	0	1.22
2 1/2:1 Downstream	Drained	128.5	42°	0	2.25

CONCLUSIONS AND RECOMMENDATIONS

A. Site Preparation: We concur with the proposal to remove the muck from the foundation area of the dam. The water table is high and dewatering will be necessary.

B. Cutoff: A multiple-purpose flood-control and recreation dam is planned. The till and alluvium overlying bedrock is primarily an SP-SM. These materials are stratified and contain zones of high permeability. In order to insure that the dam functions as intended we suggest that the cutoff trench bottom on bedrock on the abutments and in the floodplain section. Cutoff to bedrock can be obtained with trench depths of 11 feet or less except where the centerline cross a "topographic high" on each side of the floodplain. In the areas of the topographic high cuts in the range of 30 feet will be necessary to bottom the trench on rock. The till may not be as variable as it appears to us and it may be possible to reduce seepage by upstream blanketing or by some other method of cutoff.

Glacial till like sample 7.1 (68W1654) contains 33 percent fines and 14 percent finer than 0.005 mm. It is classed as an SC-CL. If this type of material is available in sufficient quantity we suggest that it be used for backfill. The permeability rate of this material placed at 95 percent of Proctor density would be very low.

If material like sample 7.1 is not available or if it cannot be easily identified in the field, material like sample 4.1 or sample 214.1 may be used. We suggest that it be placed at approximately 100 percent of Proctor density with the control on the minus No. 4 fraction in order to insure uniform low permeability fill. We suggest a placement moisture content wet of optimum if possible.

It might be possible to reduce excavation by locating the cutoff upstream from centerline.

B-95

C. Principal Spillway: The proposed location for the principal spillway is near the base of the left abutment. This location was selected in the field as best location of several alternates studied. The bedrock profile at this location is somewhat irregular and it occurs at depths of from about 5 feet to 14 feet. The alluvium overlying the bedrock is described as loose to very compact and pervious. The water table occurs at or above ground surface and the blow count varies from two blows per foot to more than 200 blows per foot. It appears, on the basis of this information, that it would be desirable to excavate the principal spillway trench to a uniform gradient in or on bedrock and to backfill the trench with material like that suggested for the cut-off trench. Consolidation of the backfill under the conduit would be very low as indicated by the consolidation data obtained on the permeability test specimens.

D. Drain: A drain is suggested to control the phreatic line in the embankment and to provide a safe outlet for seepage from the foundation. As a minimum, a trench drain is suggested at about c/b = 0.6. We suggest that the drain tap the most pervious stratum in the upper 10 feet and that it extend up the abutment to permanent pool elevation.

We suggest that the filter-drain completely encompass the conduit on the drain line.

The suggested filter limits are shown on the attached form SCS-130.

E. Embankment Design:

1. Placement of Materials: The materials available for use in the embankment are those represented with the gradation curves plotted on the attached form SCS-353. It is primarily on SP-SM. If it is possible to select enough material like sample 7.1 for a thin core section in the embankment this would be highly desirable because it would result in a core with low permeability and the placement density could be controlled to a minimum of 95 percent of standard Proctor.

If it is not possible to use the finer grained materials as discussed in the cutoff section of the report then we suggest that a core section be constructed of the till like the sample represented with the grain size plots on form SCS-353 by placing them at near 100 percent of Proctor density with the density controlled on the minus #4 fraction. We suggest a placement moisture content slightly on the wet side of standard Proctor optimum.

7 -- C. H. Dingle -- 4/22/68
Lorn P. Dunnigan
Subj: L.S 22-5, New Hampshire WP-08, Dead River, Site No. 1

The shell sections would also consist of till but the control could be by method specification. We suggest that the method specified result in a density of about 128 pcf or higher.

The consolidation data on the permeability samples indicate that there will be very little difference in the consolidation potential of the material placed at 95 percent of Proctor and the material placed at 100 percent of Proctor so differential settlement between the sections should not be a problem.

2. Slopes: The data and analyses indicate that proposed slopes have acceptable factors of safety.

3. Settlement: An overfill allowance of 0.5 foot is suggested to compensate for residual settlement in the fill and foundation.

F. Dike: It is proposed to construct the dike out of material like that used in the embankment and 3:1 slopes are planned. This appears to be adequate.

Lorn P. Dunnigan

cc:
C. H. Dingle, Durham (3)
N. F. Bogner, Upper Darby

DETAILED GEOLOGIC INVESTIGATION OF DAM SITE

Report No. NH-770G

Investigated by:

William A. Bonin, Geologist
Durham, New Hampshire
C. R. Penney, Field Assistant
Plymouth, New Hampshire

November 21, 1967

GENERAL

State	: New Hampshire	Dam No.	: 1
County	: Coos	Fund Class	: WP-08 (2006)
Township	: Berlin	Structure Class:	c
Watershed:	Dead River	Site Group	: I

SITE DATA

Drainage area	: 6.48 square miles (4,147 acres)
Type of structure	: earth
Purpose	: flood control and recreation
Valley trend	: east (downstream)
Maximum height of fill	: 45 feet
Length of fill	: 2,935 feet
Volume of compacted fill	: 236,000 cubic yards
Steepness of abutments	: 50% and 10% left; 10% and 2% right
Emergency spillway width	: 100 feet

DETAILED GEOLOGIC INVESTIGATION OF DAM SITE

Report No. NH-770B

Investigated by: 12/19/67

William A. Bonin

William A. Bonin, Geologist

Durham, New Hampshire

C. R. Penney, Field Assistant

Plymouth, New Hampshire

November 21, 1967

GENERAL

State	: New Hampshire	Dam No.	: 1
County	: Coos	Fund Class	: WP-08 (2006)
Township	: Berlin	Structure Class:	c
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Emergency spillway width	: 100 feet

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-112	DRAWING NO. SHEET 1 OF 12 DATE

DAM

19. Aside from the two low saddles, the foundation and borrow soils are represented by sample 53.1 and 59.1. This overburden is generally semi-pervious and dense. It correlates to the fill material (See item1).

20. Up to 5 feet of muck was probed in the low, wet saddles. Beneath the muck there is ½ to 2 feet of compact and semi-pervious silty sands (Sample 52.1) over compact and very pervious, gravels and sands (Sample 52.2) with 15% hard, rounded cobbles and boulders to 18 inches.

21. The depth to bedrock is an assumed depth in this area and the thickness of the outwash is unknown.

to be very pervious. The most pervious material is the "open-work" cobbles and boulders (See TP-5 from 2 to 5 feet). Sample 502.1 represents the finer gradation of the variable outwash.

11. The bedrock has overall adequate "in-place" strength. Leakage rates through the bedrock are minor or insignificant.

DIVERSION AREA

12. There are many surface boulders. The overburden is generally shallow. Sample 10.1 represents most of this material. The water level is at or a few feet above the hard bedrock surface.

13. Sample 904.1 represents a limited area of pervious, coarse-grained soil.

BORROW AND EMERGENCY SPILLWAY AREA

14. The topographic map of the bedrock is contoured to the top of the bedrock surface. A small amount of this rock, as in TP-211 (5 to 9 feet) and DH-208 (10 to 18 feet), can be excavated as earth.

15. Additional borrow is available to the west of this area (See TP's -102, -201, -204).

16. The pegmatite and Oliverian granite are obviously durable rocks. The schistose rock is a non-durable, soft, degradable rock. These rock types can be selected or rejected for use as riprap by field examination.

17. The selection or rejection of the biotite gneisss for use as riprap will present problems as noted:

    (a) Where granitized, it has the hardness and durability of the granite.

    (b) Elsewhere it is hard and granular with friable surfaces or decomposed to some depth (4' in TP-211, 3' in TP-501, 5' in TP-502).

    Abrasion and soundness tests may assist in the determination of suitability for riprap.

ADDITIONAL BORROW AREA

18. The high knob centered at DH-153 is a good source of fill. More borrow is available to the west of this area (See TP's -151 and -152). The material is represented by sample 4.1. It correlates to the fill material (See item 1).

COMMENTS AND CONCLUSIONS

1. Sample 211.1 and the correlation samples (namely: 4.1, 59.1, 207.1 and 221.1) represent our fill material and most of the overburden at the site. This material is relatively dry (4.6% moisture), somewhat cemented and difficult to excavate. It includes hard, subangular to subrounded rocks as follows:

3%	3" - 6"	
2%	6" - 12"	
1%	12" - 18"	plus occasional larger boulders

This soil in-place is dense and semi-pervious. Most of the cobbles and boulders are near the surface.

2. Surface boulders in the borrow and emergency spillway area total:

53 cubic yards per acre	6" - 18"
311 cubic yards per acre	18" - 36"

3. Surface boulders elsewhere on the site total:

35 cubic yards per acre	6" - 18"
173 cubic yards per acre	18" - 36"

4. There is also 4,250 cubic yards of boulder rock excavation within the grid survey (See drawing sheets 2 and 3).

5. Core material and quality drain fill materials in sufficient quantity are not available on site or within reasonable distance of the site.

AT THE DAM

6. Sample 7.1 represents the overburden in the high "topo" feature that crosses the right abutment.

7. Sample 211.1 is similar to the overburden in the high "topo" feature along the left abutment. Sample 503.2 represents a very pervious inclusion in an otherwise semi-pervious abutment.

8. The foundation is wet except for the high ground along the centerline.

9. There is up to 6.5 feet of muck across the low area in the foundation. The bedrock surface is very irregular in this area. There is some 10 feet of near vertical relief on the bedrock surface. There are outcrops and bedrock was cored at depths of up to 19 feet.

10. The overburden across the low area is thick and variable in type, strength and permeability. Some strata within this outwash are observed

The underlying bedrock generally consists of hard, sound and durable, weakly foliated Oliverian granite, hard granular textured biotite gneiss and occasional highly weathered schists.

Exceptions:

Four feet of bedrock (biotite gneiss) was easily excavated from 5 - 9 feet in test pit (TP-211)

Eight feet of very soft biotite-hornblende schist was cored from 10 to 18 feet. Core recovery in similar material was very low.

DIKE

There are no bedrock outcrops in this area. Surface rocks are common but they are not as numerous as at the dam. The areal extent of outwash and till material was determined in the test pitting program. The vertical extent of these materials and the depth to bedrock was not determined.

Except for the area of the saddles, the overburden is glacial till. Up to 5 feet of muck was probed in the saddles. The underlying outwash deposits consist of 0.5 to 2.0 feet of compact and semi-pervious gray GM soil (15% silt and 10% hard, subangular to subrounded gravel) over compact and pervious SP-GM and GP-GM soil. (40 - 60% hard rounded gravels to 3 inches, 5% silt and 15% hard, rounded cobbles and boulders to 18 inches). The water level is at or near the surface and the pit walls were caving. In test pit (TP-57) the ground water was a bright iridescent orange color.

The glacial till in the foundation and adjacent borrow areas is an SM and SP-SM soil. It has 10 - 25% hard, subangular gravel to 3 inches and 10 to 15% silt. It is dense and semi-pervious to pervious. It includes up to 25% hard, subangular rocks from 3 to 24 inches.

In the borrow areas, oversize material includes hard, subangular to subrounded rock as follows:

5%	3" - 6"
5%	6" - 12"
10%	12" - 24"

REFERENCE:

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

B-108

SHEET

There are numerous hard, subangular surface rocks in the above discussed areas, that is:

35 cubic yards per acre from 6 to 18" in size
173 cubic yards per acre from 18" to 36" in size
plus
(rocks over one cubic yard as noted on sheets 2 and 3)

EMERGENCY SPILLWAY AND PRIMARY BORROW AREA

This area has many hard, subangular surface rocks. There are 53 cubic yards per acre from 3 to 18 inches and 311 cubic yards per acre from 18 to 36 inches. Boulders well over one cubic yard are common. Much of the topsoil in this area has been lost to sheet erosion following forest fires.

The upper few feet of the till (usually one foot but up to 6 feet) are a more rocky SM soil. The overburden is otherwise a less silty sand (SP-SM) with 25% hard, subangular gravel to 3 inches and 10% silt (i.e. non-plastic fines with no dry strength). This material is light olive-tan color, only slightly moist, very dense and semi-pervious. It contains 5% hard subangular rocks to 18 inches. Some of the gravel and plus three inch material is decomposed. Occasional large boulders (some over one cubic yard) occur within the overburden.

IN PLACE TEST DATA

TP - 205 @ 5.0' dry density 118.9 #/Ft^3
4.6% moisture on - 3/4"

TP - 207 @ 5.0' dry density 106.2 #/Ft^3
4.6% moisture on - 3/4"

The following particle-size distribution curve (field determination on dry sieve) is typical of the borrow material:

REFERENCE:

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
B-107

DRAWING NO.

SHEET

DATE

The bedrock encountered in these excavations includes hard pegmatite, granite and biotite gneiss.

AREA UPSTREAM FROM THE RIGHT WING OF THE DAM BETWEEN JERICHO BROOK AND THE RESERVOIR

It is through this area that Jericho Brook will be diverted into the reservoir basin. An aqueduct system, as along the broken profile from test pits (TP-11) to (TP-907), may be constructed to maintain water quality through circulation in the reservoir basin.

In test pits (TP-A, -B, -C, -D, -E, -F) hard and granular bedrock (biotite gneiss) was encountered at depths of 2.5 to 4.5 feet. The overburden is a loose and pervious alluvium till with 20% silt and less than 5% gravel. The water level is at or immediately above the bedrock surface. In test pit (TP-F), the furthest downslope of the lettered pits, hard, pink granite was encountered at 6 feet.

Test pits (TP-11, -901 to -903) encountered hard bedrock within 3.5 feet of the surface. The overburden is a moist, silty sand with less than 5% hard angular gravel to 3 inches and 20% silt. Test pits (TP-904, -905) were dug to 10 feet. Bedrock was probably encountered at the bottom of test pit (TP-905). The overburden is dry, pervious and compact gravelly sands and sandy gravels with 10% silt and 40 to 60% hard subangular to subrounded gravel. This coarse material (SP-SM and GP-GM) has 30% hard subangular to subrounded cobbles and boulders to 24 inches. Test pits (TP-906 to -910) encountered hard bedrock within 6 feet of the surface. The overburden is wet. It consists of muck, boulders and very little SM soil with SM-ML inclusions. The overburden includes up to 60% hard angular to subangular cobbles and boulders to 24 inches. The underlying bedrock includes granular textured biotite gneiss, coarse grained granite and pegmatite.

ADDITIONAL BORROW AREAS

Section KK', through the high topographic feature, demonstrates a thick section of till. Drill hole (DH-153) penetrated 49 feet of overburden, which is some 25 feet below the water surface elevation in the swamp. The water level in this boring, measured 8 days after completion of the boring, was at 10.5 feet. The bottom 10 feet of this boring consist of lodgment till that was smeared into a depression in the bedrock surface. The overburden is otherwise the usually sandy till; i.e., silty sands w/15% silt and 15% hard angular gravel, semi-pervious to pervious, and dense. Test pit (TP-4) showed the water-worked inclusions within this sandy till. In one such inclusion at 22 feet in drill hole (DH-153) a permeability rate of 2.6 feet per day was recorded.

Test pit (TP-151) and test pit (TP-152) on section LL' were excavated 5 to 10 feet into the sandy till (SM with 10% silt). Refusal at those depth was presumably near bedrock. The overburden contains up to 35% subangular cobbles and boulders to 1 cubic yard.

REFERENCES	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B106	DRAWING NO. SHEET DATE

D.H No.	Test Section(NX) (fr. - to)	Pressure Loss (psi/min)	W.L. (ft)	Head (ft)	Q (gpm)	K (fpd)
303	20.5 - 25.5	greater than 10	2.1	48.1	0.2	0.09
	25.5 - 28.5	less than 10	2.1	48.1	none	--
504	16.5 - 21.5	less than 5	2.6	48.6	none	--
	21.5 - 26.5	less than 10	2.6	48.6	none	--
505	20.0 - 25.0	less than 5	0.0	46.0	none	--
	24.0 - 29.0	none	0.0	46.0	none	--
	29.0 - 34.0	none	0.0	46.0	none	--
18	12.0 - 17.0	less than 10	0.0	34.5	none	--

An occasional partial loss of drill water was noted while coring in drill hole (DH-18). A temporary artesian flow, estimated at 2 gpm, was noted from 15 to 16 feet in drill hole (DH-302) and from 37.5 feet in drill hole (DH-18).

Right Abutment (base of abutment to top of dam)

Except for the high topographic feature investigated with drill hole (DH-19) and test pit (TP-7), this is an area of extensive outcrops and very thin overburden.

Test pit seven (TP-7) was excavated 11 feet into very dense and impervious till. This material is a silty fine to medium sand with 20% silt and less than 5% gravel. There are occasional decomposed and hard subangular pink granite cobbles to 12 inches. The drill hole (DH-19) encountered similar soil to 27 feet and pegmatite was cored from 27 to 52 feet. The overburden took no water; and except for the test section from 37.0 to 42.0, where packers could not be seated, the bedrock took no water.

The outcrops include hard and durable pegmatite and associated graphic granite. Relatively hard to highly weathered bitite gneiss outcrops between sills of hard pegmatite in the channel bank.

Test pits (TP-9, -11, and -13) were dug 2 feet to bedrock. Test pit (TP-10) was dug to refusal at 6 feet (presumably bedrock). The overburden is generally a firm and pervious SM till with 5% hard angular rock to eighteen inches. In test pit (TP-10) the water level is at 3 feet; in test pit (TP-11) the water level is at the surface.

Test pit (TP-14), the highest excavation on this abutment, was dug in an obscurely stratified till to bedrock at 9 feet. The material is firm and pervious to semi-pervious. It includes silty sands and sandy silts with pockets of medium to coarse sand. Some boulders to one cubic yard were encountered. The water level in November 1966 was at 3 feet. In August 1967 water was brought to the surface by running test pitting equipment over the backfilled pit.

the proposed embankment.

The water level is at or near the surface.

Bedrock outcrops in this area. The outcrops include hard and durable pegmatite, graphic granite and some biotite gneiss.

The overburden is up to 19 feet thick. It consists of firm to dense, semi-pervious sands with 15% silt and 10% gravel (SM); loose to very compact, pervious, stratified sands with up to 20% silt and 30% gravel (SP to SM); and openwork rounded and subrounded cobbles and boulders (40% larger than 3 inches, the minus 3 inch is a loose and very pervious GP with 80% larger than ¼ inch).

The cored bedrock varied in type and quality. Core recoveries as low as 18, 20 34 and 42% for 5 foot runs are recorded. It appears that only hard pegmatite was recoved in core runs that penetrated both the pegmatite and biotite gneiss. The poorest recoveries occurred in the granular, friable and sometime decomposed biotite gneiss. In drill hole (DH-505) an A-rod was driven 1.5 feet into the biotite gneiss between two core runs.

Bedrock was excavated in test pits (TP-501, -602). In test pit (TP-501) the bedrock from 5 to 8 feet came out in decomposed rock fragments that broke down to SM soil and thin angular slabs of fresh rock up to 18 inches in maximum dimension. Much water was flowing through this zone. The bedrock (biotite gneiss) at 8 feet is hard and fractured. In test pit (TP-602) the biotite gneiss was decomposed and easily excavated from 3 to 8 feet. At 8 feet the rock is hard.

Permeability tests in the overburden are not indicative of the actual leakage through the variable, alluvium outwash material. The inability to effectively seat the casing and high water table and low head conditions resulted in negative test results and insignificant flows.

The overall quality of the bedrock hindered or precluded pressure testing much of the bedrock.

(1) In DH-301, packers couldn't enter the cored rock.
(2) In DH-302, packers couldn't be seated at all.
(3) In DH-303, the packers couldn't be seated from 9.5 to 20.5.
(4) In DH-504, the packers couldn't be seated from 10.5 to 15.5.
(5) In DH-18, the packers couldn't be seated from 17.0 to 28.0

The following pressure test data was obtained:

Test Depth (ft)	Casing Size	W.L. (ft)	Head (ft)	Q (gpm)	K (fpd)
10.0	4"	20.5	10.6	1.1	22.8
20.0	4"	20.5	21.0	12.0	125 1/
20.0	4"	18.2	19.2	9.0	103 2/
25.0	4"	20.5	20.5	0.3	3.2

1/ Turbulent flow Q/A = 0.34 fps
2/ Turbulent flow Q/A = 0.25 fps

In drill holes (DH-16, -17) the water level is deep; i.e., 21.4 and 20.5 feet.

In drill hole (DH-15), near the top of dam elevation, the water level is shallow; i.e., 1.7 feet.

The bedrock includes pegmatite, granite, granitized biotite gneiss and biotite gneiss. With the exception of the biotite gneiss, which is slightly friable along fracture, the bedrock is other wise hard, sound and durable.

Summary of Pressure Testing Results:

D.H. No.	Test Section(NX) (fr. - to)	Pressure Loss (psi/min)	W.L. (ft)	Head (ft)	Q (gpm)	K (fpd)
15	11.0 - 16.0	less than 10	1.7	54.7	none	--
	15.0 - 20.0	none	1.7	51.2	none	--
	20.0 - 25.0	less than 10	1.7	52.4	7.2	3.1
16	26.3 - 46.0	greater than 10	21.4	67.4	4.6	0.5
17	31.0 - 40.0	less than 5	20.5	66.5	none	--

Test pit (TP-503) was dug into the steep abutment slope in the downstream section of this glacial till feature. The upper 11 feet of till is typical of the feature; i.e., silty sands with 5% hard subangular gravel to 3 inches, 15% silt, moist, dense and semi-pervious. The section from 11 to 14 feet is a water-worked inclusion in the till deposit. It is a silty sand with 20% coarse sand to ¼ inch, 20% silt, wet, dense and pervious. The high permeability rates in drill hole (DH-17) probably occurred in a similar material.

Foundation (between base of abutments)

This area was investigated with four test pits (TP-501, -502, -5, -602) and six drill holes (DH-501, -502, -503, - 504, -505 and -18).

This low area was also extensively probed on 50-foot centers. There is up to 6.5 feet of muck, average thickness 1.5 feet, within the base width of

GENERAL

From October 27 to November 7, 1966, a Unit 3/4-yard backhoe (model 1020) and Caterpillar D-6 bulldozer were used to excavate 41 test pits in the foundation area of the dam and emergency spillway-borrow area. Twenty-six additional test pits were excavated from August 1 to August 8, 1967, using a John Deer backhoe (model JD-350) and Caterpillar D-6 bulldozer. The additional test pits were dug in the foundation and borrow areas of the dike, the area between Jericho Brook and the basin, and emergency spillway area.

The drilling program, 21 borings totaling 674 feet, was accomplished from May 25 to July 13, 1967, using 2 skid-mounted drill rigs -- Acker RB, belt drive, hand feed, 36 h.p. and S&H 35 H, hydraulic, 28 h.p. with an Oliver OC-4 tractor.

Thirteen (13) large disturbed samples have been submitted to the Soils Lab for testing and correlation. Some 75 feet of NX core from six (6) borings have also been submitted for durability tests.

FOUNDATION AREA OF THE DAM

Left Abutment (top of dam to base of abutment)

Four test pits (TP-1, -2, -601, -503) and three drill holes (DH-15, -16, -17) delineate this feature. It is a thick deposit of till (26 to 27 feet) which thins to 10 feet near the top of dam elevation.

Test pits (TP-1, -2, -601) located at the base of the hill on the upstream side of the feature, encountered bedrock at 5 to 7.5 feet.

In test pit (TP-1), 1.5 feet of the bedrock (biotite gneiss) was decomposed and easily excavated. In test pit (TP-2), the biotite gneiss was hard and durable from the surface. The water level in these pits is at the surface. This overburden is a rather non-discript bouldery till (SP-SM, SM and ML) with a foot of surface muck. It is wet, loose to firm and pervious to semi-pervious.

Drill holes (DH-16, -17) put down through the top of the feature, encountered the thick section of SM till with 15% silt. This overburden is dense to very dense and generally semi-pervious. In drill hole (DH-16), the overburden accepted no water. In drill hole (DH-17), drill water was lost in a very pervious zone from 18.5 to 20.0 feet and the following permeability test results were obtained:

The outwash material between the till features in the foundation of the dam includes sands, gravels and openwork cobbles and boulders. This material is pervious to very pervious and is generally compact. It is up to 19 feet thick and directly overlies bedrock. Outwash also occurs in both saddles in the foundation of the dike. This material includes compact and pervious to very pervious sands and gravels to a depth of over 11 feet.

Muck in the foundation of the dam is up to 6.5 feet thick. In the foundation of the dike up to 5.0 feet of muck was probed.

In contrast to the homogeneous glacial till overburden, the bedrock is structurally complex and variable in type and quality. Oliverian granite intrudes the Ammonoosuc volcanics at the dam site.

The Oliverian granite is a weakly foliated, pink to gray, medium to coarse-grained rock. The principal dark mineral is biotite, which constitutes only a few percent of the rock. Pink pegmatite with occasional graphic intergrowths of quartz and feldspar are associated with the granite. The pegmatites range in size from small dikes and sills (defined by our shallow borings) to larger tabular bodies (greater than 25 feet thick). The granite and pegmatite are hard, sound and durable.

The Ammonoosuc volcanics include biotite gneiss, biotite schist and biotite-hornblende schist.

The gneiss is a fine-grained, dark gray rock consisting of quartz, biotite, plagioclase and potash feldspar. It is generally well foliated and has a fragmental texture. As a rule the weathered surface is granular, friable and disintegrates rather readily. The unweathered rock is apparently sound. There is a granitized zone within the gneiss in contact with the Oliverian granite. The more schistose rock is deeply weathered and decomposed.

The rock structure strikes North 10 to 30° East and dips 5 to 30° Southeast.

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B101	BORING NO. SHEET NO. DATE

The site is located in the very rugged White Mountain Region of northern New Hampshire. It is within the dissected and glaciated Upland section of the New England Physiographic Province.

Drainage from the northeast flank of Black Crescent Mountain forms Jericho Brook which flows past the reservoir basin, a large upland swamp near the watershed divide. The drainage area controlled is 6.5 square miles, of which 5.7 square miles is diverted from Jericho Brook. Continental glaciation in a mountainous area has created a situation where a large reservoir basin is without a correspondingly large drainage area.

Except for the area of the swamp, the overburden consists of glacial till as ground moraine. This till was carried in and on the ice and not deposited until the ice became stagnant and melted. With continued thinning and retreat of the ice sheet to the northwest, a large volume of glacial meltwater flowed over the watershed divide. This huge glacial river entered the watershed at the location of the dike. It flowed through the area of the upland swamp. And in a complex cycle of glacial-fluvial erosion and deposition, it created and destroyed a temporary glacial lake and cut the spectacular "pothole" at the outlet of the swamp. When deglaciation of the area was complete, the glacial water course was left high and virtually "dry" on the watershed divide. Since immediate post glacial time, the only water that flows into the pothole results from direct rainfall in the basin and unusual flood flows which spill over from Jericho Brook into the upland swamp. In more recent time, that is about 70 years ago, the area was burned over and much of the topsoil was lost to sheet erosion.

The perimeter of the basin is extremely bouldery. Very large boulders, 50 to 150 cubic yards or so, are common. With the exception of the topographic high features in the vicinity of the centerline of the dam and the closed high feature north of the emergency spillway, the glacial till is generally thin or absent. This till was somewhat water-worked at the time of deposition. Lenses of clean, sorted sands with obscure stratification and flow structure around cobbles occurs occasionally within an otherwise massively structured till. The till is rather homogeneous throughout the area. It is an SP-SM and SM soil with 20 to 25% subangular gravel to 3 inches, 10 to 15% silt, 10% coarse sand and 55% fine to medium sands. It is only slightly moist and generally dense and semi-pervious. The coarse fraction, except for occasional decomposed gravel particles and cobbles, is hard, sound and durable. The fine fraction is non-plastic and has no dry strength. The till was excavated with difficulty due to the cobbles, boulders and high percentage of gravel being held firmly within the matrix. This matrix is relatively dry and shows slight iron oxide cementation. The upper few feet of the till (usually one foot but up to 5 or 6 feet depending on the amount of post glacial and recent erosion) contains 5% - 3 to 6 inch, 4% - 6 to 12 inch and 1% - 12 to 18 inch subangular rocks. Beneath the surface till 3 to 18-inch rocks constitute 5% of the material. Over one cubic yard boulders can occur anywhere in the glacial till overburden.

NOTE: This site involves construction of the following:

(a) Dike, 1,665 feet long and 14 feet high, along the watershed divide.

(b) Diversion and flood way to conduct Jericho Brook, 5.66 square miles (3,622 acres) drainage area, into the reservoir basin.

(c) An aqueduct system to maintain water quality through circulation in the reservoir basin.

STORAGE ALLOCATION

	Volume (acre-feet)	Surface Area (acres)	Depth at Dam (feet)	Depth at Dike (feet)
Sediment pool	5	3	--	--
Recreation pool	1,257	135	25	--
Floodwater pool	1,417	174	35	4

REFERENCE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
B-99

DRAWING NO.

SHEET

NOTE: This site involves construction of the following:

(a) Dike, 1,665 feet long and 14 feet high, along the watershed divide.

(b) Diversion and flood way to conduct Jericho Brook, 5.66 square miles (3,622 acres) drainage area, into the reservoir basin.

(c) An aqueduct system to maintain water quality through circulation in the reservoir basin.

STORAGE ALLOCATION

	Volume (acre-feet)	Surface Area (acres)	Depth at Dam (feet)	Depth at Dike (feet)
Sediment pool	5	3	--	--
Recreation pool	1,257	135	25	--
Floodwater pool	1,417	174	35	4

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-113	DRAWING NO. SHEET 2 OF 12 DATE

GENERAL GEOLOGY

The site is located in the very rugged White Mountain region of northern New Hampshire. It is within the dissected and glaciated Upland Section of the New England Physiographic Province.

Drainage from the northeast flank of Black Mountain basin forms Jericho Brook which flows past the reservoir basin. There is a upland swamp near the watershed divide. The drainage area controlled is 6.8 square miles, of which 5.7 square miles is diverted from Jericho Brook. Continental glaciation in a mountainous area has created a situation where a large reservoir basin is without a correspondingly large drainage area.

Except for the area of the swamp, the overburden consists of glacial till as ground moraine. This till was carried in and on the ice and not deposited until the ice became stagnant and melted. With continued thinning and retreat of the ice sheet to the northwest, a large volume of glacial meltwater flowed over the watershed divide. This huge glacial river entered the watershed at the location of the dike. It flowed through the area of the upland swamp. And in a complex cycle of glacial-fluvial erosion and deposition, it created and destroyed a temporary glacial lake and cut the spectacular "pothole" at the outlet of the swamp. When deglaciation of the area was complete, the glacial water course was left high and virtually "dry" on the watershed divide. Since immediate post glacial time, the only water that flows into the pothole results from direct rainfall in the basin and unusual flood flows which spill over from Jericho Brook into the upland swamp. In more recent time, that is about 70 years ago, the area was burned over and much of the topsoil was lost to sheet erosion.

The perimeter of the basin is extremely bouldery. Very large boulders, 50 to 150 cubic yards or so, are common. With the exception of the topographic high features in the vicinity of the centerline of the dam and the closed high feature north of the emergency spillway, the glacial till is generally thin or absent. This till was somewhat water-worked at the time of deposition. Lenses of clean, sorted sands with closure stratification and flow structure around cobbles occurs occasionally within an otherwise massively structured till. The till is rather homogeneous throughout the area. It is an SP-SM and SM soil with 10 to 25% subangular gravel to 3 inches, 10 to 15% silt, 1% coarse sand and 5% fine to medium sands. It is only slightly moist and generally dense and semi-pervious. The coarse fraction, except for occasional decomposed gravel particles and cobbles, is hard, sound and durable. The fine fraction is non-plastic and has no dry strength. The till was excavated with difficulty due to the cobbles, boulders and high percentage of gravel being held firmly within the matrix. This matrix is relatively dry and shows slight iron oxide cementation. The upper few feet of the till (usually one foot but up to 5 or 6 feet depending on the amount of post glacial and recent erosion) contains 5% - 3 to 6 inch, 4% - 6 to 12 inch and 1% - 12 to 18 inch subangular rocks. Beneath the surface till 3 to 18-inch rocks constitute 5% of the material. Oversize cubic yard boulders can occur anywhere in the glacial till overburden.

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-114	DRAWING NO. SHEET 1 OF 12 DATE

The outwash material between the till features in the foundation of the dam includes sands, gravels and openwork cobbles and boulders. This material is pervious to very pervious and is generally compact. It is up to 19 feet thick and directly overlies bedrock. Outwash also occurs in both saddles in the foundation of the dike. This material includes compact and pervious to very pervious sands and gravels to a depth of over 11 feet.

Muck in the foundation of the dam is up to 6.5 feet thick. In the foundation of the dike up to 5.0 feet of muck was probed.

In contrast to the homogeneous glacial till overburden, the bedrock is structurally complex and variable in type and quality. Oliverian granite intrudes the Ammonoosuc volcanics at the dam site.

The Oliverian granite is a weakly foliated, pink to gray, medium to coarse-grained rock. The principal dark mineral is biotite, which constitutes only a few percent of the rock. Pink pegmatite with occasional graphic intergrowths of quartz and feldspar are associated with the granite. The pegmatites range in size from small dikes and sills (defined by our shallow borings) to larger tabular bodies (greater than 25 feet thick). The granite and pegmatite are hard, sound and durable.

The Ammonoosuc volcanics include biotite gneiss, biotite schist and biotite-hornblende schist.

The gneiss is a fine-grained, dark gray rock consisting of quartz, biotite, plagioclase and potash feldspar. It is generally well foliated and has a fragmental texture. As a rule the weathered surface is granular, friable and disintegrates rather readily. The unweathered rock is apparently sound. There is a granitized zone within the gneiss in contact with the Oliverian granite. The more schistose rock is deeply weathered and decomposed.

The rock structure strikes North 10 to 30° East and dips 5 to 30° Southeast.

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-115	DRAWING NO. SHEET 11 OF 12 DATE

SUMMARY OF FINDINGS

GENERAL

From October 27 to November 7, 1966, a Unit 3/4-yard backhoe (model 1020) and Caterpillar D-6 bulldozer were used to excavate 41 test pits in the foundation area of the dam and emergency spillway-borrow area. Twenty-six additional test pits were excavated from August 1 to August 8, 1967, using a John Deer backhoe (model JD-350) and Caterpillar D-6 bulldozer. The additional test pits were dug in the foundation and borrow areas of the dike, the area between Jericho Brook and the basin, and emergency spillway area.

The drilling program, 21 borings totaling 674 feet, was accomplished from May 25 to July 21, 1967, using 2 skid-mounted drill rigs -- Acker RG, belt drive, hand feed, 36 h.p. and CME 35 H, hydraulic, 28 h.p. with an Oliver OC-4 tractor.

Thirteen (13) large disturbed samples have been submitted to the Soils Lab for testing and correlation. Some 75 feet of NX core from six (6) borings have also been submitted for durability tests.

FOUNDATION AREA OF THE DAM

Left Abutment (top of dam to base of abutment)

Four test pits (TP-1, -2, -601, -503) and three drill holes (DH-15, -16, -17) delineate this feature. It is a thick deposit of till (26 to 27 feet) which thins to 10 feet near the top of dam elevation.

Test pits (TP-1, -2, -601) located at the base of the hill on the upstream side of the feature, encountered bedrock at 5 to 7.5 feet.

In test pit (TP-1), 1.5 feet of the bedrock (biotite gneiss) was decomposed and easily excavated. In test pit (TP-2), the biotite gneiss was hard and durable from the surface. The water level in these pits is at the surface. This overburden is a rather non-discript bouldery till (SP-SM, SM and ML) with a foot of surface muck. It is wet, loose to firm and pervious to semi-pervious.

Drill holes (DH-16, -17) put down through the top of the feature, encountered the thick section of SM till with 15% silt. This overburden is dense to very dense and generally semi-pervious. In drill hole (DH-16), the overburden accepted no water. In drill hole (DH-17), drill water was lost in a very pervious zone from 18.5 to 20.0 feet and the following permeability test results were obtained:

Text Depth (ft)	Casing Size	W.L. (ft)	Head (ft)	Q (gpm)	K (fpd)
10.0	4"	20.5	10.6	1.1	22.0
20.0	4"	20.5	21.0	12.0	125 1/
20.0	4"	18.2	19.2	9.0	103 2/
25.0	4"	20.5	20.5	0.3	3.2

1/ Turbulent flow Q/A = 0.34 fps
2/ Turbulent flow Q/A = 0.25 fps

In drill holes (DH-16, -17) the water level is deep; i.e., 21.4 and 20.5 feet.

In drill hole (DH-15), near the top of dam elevation, the water level is shallow; i.e., 1.7 feet.

The bedrock includes pegmatite, granite, granitized biotite gneiss and biotite gneiss. With the exception of the biotite gneiss, which is slightly friable along fracture, the bedrock is other wise hard, sound and durable.

Summary of Pressure Testing Results:

D.H. No.	Test Section(NX) (fr. - to)	Pressure Loss (psi/min)	W.L. (ft)	Head (ft)	Q (gpm)	K (fpd)
15	11.0 - 16.0	less than 10	1.7	54.7	none	--
	15.0 - 20.0	none	1.7	51.2	none	--
	20.0 - 25.0	less than 10	1.7	52.4	7.2	3.1
16	26.3 - 46.0	greater than 10	21.4	67.4	4.6	0.5
17	31.0 - 40.0	less than 5	20.5	66.5	none	--

Test pit (TP-503) was dug into the steep abutment slope in the downstream section of this glacial till feature. The upper 11 feet of till is typical of the feature; i.e., silty sands with 5% hard subangular gravel to 3 inches, 15% silt, moist, dense and semi-pervious. The section from 11 to 14 feet is a water-worked inclusion in the till deposit. It is a silty sand with 20% coarse sand to ¼ inch, 20% silt, wet, dense and pervious. The high permeability rates in drill hole (DH-17) probably occurred in a similar material.

Foundation (between base of abutments)

This area was investigated with four test pits (TP-501, -502, -5, -602) and six drill holes (DH-301, -302, -303, - 504, -505 and -18).

This low area was also extensively probed on 50-foot centers. There is up to 6.5 feet of muck, average thickness 1.5 feet, within the base width of

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-117	DRAWING NO. SHEET 1 OF 16 DATE

the proposed embankment.

The water level is at or near the surface.

Bedrock outcrops in this area. The outcrops include hard and durable pegmatite, graphic granite and some biotite gneiss.

The overburden is up to 19 feet thick. It consists of firm to dense, semi-pervious sands with 15% silt and 10% gravel (SM); loose to very compact, pervious, stratified sands with up to 20% silt and 30% gravel (SP to GM); and openwork rounded and subrounded cobbles and boulders (60% larger than 3 inches, the minus 3 inch is a loose and very pervious GP with 5% larger than ¼ inch).

The cored bedrock varied in type and quality. Core recoveries as low as 7%, 8%, 9% and 10% for 5 foot runs are recorded. It appears that only hard pegmatite was recoved in core runs that penetrated both the pegmatite and biotite gneiss. The poorest recoveries occurred in the granular, friable and sometime decomposed biotite gneiss. In drill hole (DH-505) an A-rod was driven 1.5 feet into the biotite gneiss between two core runs.

Bedrock was excavated in test pits (TP-501, -602). In test pit (TP-501) the bedrock from 5 to 8 feet came out in decomposed rock fragments that broke down to SM soil and thin angular slabs of fresh rock up to 16 inches in maximum dimension. Much water was flowing through this zone. The bedrock (biotite gneiss) at 8 feet is hard and fractured. In test pit (TP-602) the biotite gneiss was decomposed and easily excavated from 3 to 8 feet. At 8 feet the rock is hard.

Permeability tests in the overburden are not indicative of the actual leakage through the variable, alluvium outwash material. The inability to effectively test the casing and high water table and low head conditions resulted in negative test results and insignificant flows.

The overall quality of the bedrock hindered or precluded pressure testing much of the bedrock.

(1) In DH-501, packers couldn't enter the cored rock.
(2) In DH-502, packers couldn't be seated at all.
(3) In DH-503, the packers couldn't be seated from 9.5 to 20.5.
(4) In DH-504, the packers couldn't be seated from 14.5 to 24.5.
(5) In DH-505, the packers couldn't be seated from 27.0 to 38.0

The following pressure test data was obtained:

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-118	DRAWING NO. SHEET 2 OF 2 DATE

D.H No.	Test Section(NX) (fr. - to)	Pressure Loss (psi/min)	W.L. (ft)	Head (ft)	Q (gpm)	K (fpd)
303	20.5 - 25.5	greater than 10	2.1	48.1	0.2	0.09
	25.5 - 29.5	less than 10	2.1	48.1	none	--
504	16.5 - 21.5	less than 5	2.6	48.6	none	--
	21.5 - 26.5	less than 10	2.6	48.6	none	--
505	20.0 - 25.0	less than 5	0.0	46.0	none	--
	24.0 - 29.0	none	0.0	46.0	none	--
	29.0 - 34.0	none	0.0	46.0	none	--
18	12.0 - 17.0	less than 10	0.0	34.5	none	--

An occasional partial loss of drill water was noted while coring in drill hole (DH-18). A temporary artesian flow, estimated at 2 gpm, was noted from 15 to 16 feet in drill hole (DH-302) and from 37.5 feet in drill hole (DH-18).

Right Abutment (base of abutment to top of dam)

Except for the high topographic feature investigated with drill hole (DH-19) and test pit (TP-7), this is an area of extensive outcrops and very thin overburden.

Test pit seven (TP-7) was excavated 11 feet into very dense and impervious till. This material is a silty fine to medium sand with 20% silt and less than 5% gravel. There are occasional decomposed and hard subangular pink granite cobbles to 12 inches. The drill hole (DH-19) encountered similar soil to 27 feet and pegmatite was cored from 27 to 52 feet. The overburden took no water; and except for the test section from 37.0 to 42.0, where packers could not be seated, the bedrock took no water.

The outcrops include hard and durable pegmatite and associated graphic granite. Relatively hard to highly weathered bitite gneiss outcrops between sills of hard pegmatite in the channel bank.

Test pits (TP-9, -11, and -13) were dug 2 feet to bedrock. Test pit (TP-10) was dug to refusal at 6 feet (presumably bedrock). The overburden is generally a firm and pervious SM till with 5% hard angular rock to eighteen inches. In test pit (TP-10) the water level is at 3 feet; in test pit (TP-11) the water level is at the surface.

Test pit (TP-12), the highest excavation on this abutment, was dug in an obscurely stratified till to bedrock at 9 feet. The material is firm and pervious to semi-pervious. It includes silty sands and sandy silts with pockets of medium to coarse sand. Some boulders to one cubic yard were encountered. The water level in November 1966 was at 3 feet. In August 1967 water was brought to the surface by running test pitting equipment over the backfilled pit.

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B119	DRAWING NO. SHEET 5 OF 12 DATE

The bedrock encountered in these excavations includes hard pegmatite, granite and biotite gneiss.

AREA UPSTREAM FROM THE HIGH [illegible] OF THE DAM BETWEEN JERICHO [illegible] AND [illegible]

It is through this area that Jericho Brook will be diverted into the reservoir basin. An aqueduct system, as along the broken profile from test pits (TP-11) to (TP-907), may be constructed to maintain water quality through circulation in the reservoir basin.

In test pits (TP-A, -B, -C, -D, -E, -F) hard and granular bedrock (biotite gneiss) was encountered at depths of 2.5 to 4.5 feet. The overburden is a loose and pervious alluvium till with 20% silt and less than 5% gravel. The water level is at or immediately above the bedrock surface. In test pit (TP-F), the furthest downslope of the lettered pits, hard, pink granite was encountered at 6 feet.

Test pits (TP-11, -901 to -903) encountered hard bedrock within 3.5 feet of the surface. The overburden is a moist, silty sand with less than 5% hard angular gravel to 3 inches and 20% silt. Test pits (TP-904, -905) were dug to [illegible] feet. Bedrock was probably encountered at the bottom of test pit (TP-905). The overburden is dry, pervious and compact gravelly sands and sandy gravels with 10% silt and 40 to 60% hard subangular to subrounded gravel. This coarse material (SP-SM and GP-GM) has 30% hard subangular to subrounded cobbles and boulders to 24 inches. Test pits (TP-906 to -910) encountered hard bedrock within 6 feet of the surface. The overburden is wet. It consists of muck, boulders and very little SM soil with SM-ML inclusions. The overburden includes up to 60% hard angular to subangular cobbles and boulders to 24 inches. The underlying bedrock includes granular textured biotite gneiss, coarse grained granite and pegmatite.

ADDITIONAL BORROW AREAS

Section KK', through the high topographic feature, demonstrates a thick section of till. Drill hole (DH-153) penetrated 49 feet of overburden, which is some 15 feet below the water surface elevation in the swamp. The water level in this boring, measured 8 days after completion of the boring, was at 18.5 feet. The bottom 10 feet of this boring consist of lodgment till that was smeared into a depression in the bedrock surface. The overburden is otherwise the usually sandy till; i.e., silty sands w/15% silt and 15% hard angular gravel, semi-pervious to pervious, and dense. Test pit (TP-4) showed the water-worked inclusions within this sandy till. In one such inclusion at 22 feet in drill hole (DH-153) a permeability rate of 2.6 feet per day was recorded.

Test pit (TP-151) and test pit (TP-15[illegible]) on section LL' were excavated 5 to 8 feet into the sandy till (SM with 15% silt). Refusal at these depth was probably over bedrock. The overburden contains up to 35% subangular cobbles and [illegible] per cubic yard.

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-120	DRAWING NO. SHEET 2 OF 12 DATE

There are numerous hard, subangular surface rocks in the above discussed areas, that is:

35 cubic yards per acre from 6 to 18" in size
173 cubic yards per acre from 18" to 36" in size
plus
rocks over one cubic yard as noted on sheets 2 and 3

EMERGENCY SPILLWAY AND PRIMARY BORROW AREA

This area has many hard, subangular surface rocks. There are 53 cubic yards per acre from 3 to 18 inches and 311 cubic yards per acre from 18 to 36 inches. Boulders well over one cubic yard are common. Much of the topsoil in this area has been lost to sheet erosion following forest fires.

The upper few feet of the till (usually one foot but up to 6 feet) are a more rocky SM soil. The overburden is otherwise a less silty sand (SP-SM) with 25% hard, subangular gravel to 3 inches and 10% silt (i.e. non-plastic fines with no dry strength). This material is light olive-tan color, only slightly moist, very dense and semi-pervious. It contains 5% hard subangular rocks to 18 inches. Some of the gravel and plus three inch material is decomposed. Occasional large boulders (some over one cubic yard) occur within the overburden.

IN PLACE TEST DATA

TP - 205 @ 5.0' — dry density 118.9 #/Ft^3
4.6% moisture on - 3/4"

TP - 207 @ 5.0' — dry density 106.2 #/Ft^3
4.6% moisture on - 3/4"

The following particle-size distribution curve (field determination on dry sieve) is typical of the borrow material:

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-121	DRAWING NO. SHEET 10 OF 12 DATE

The underlying bedrock generally consists of hard, sound and durable, weakly foliated Oliverian granite, hard granular textured biotite gneiss and occasional highly weathered schists.

Exceptions:

Four feet of bedrock (biotite gneiss) was easily excavated from 5 - 9 feet in test pit (TP-211)

Eight feet of very soft biotite-hornblende schist was cored from 10 to 18 feet. Core recovery in similar material was very low.

DIKE

There are no bedrock outcrops in this area. Surface rocks are common but they are not as numerous as at the dam. The areal extent of outwash and till material was determined in the test pitting program. The vertical extent of these materials and the depth to bedrock was not determined.

Except for the area of the saddles, the overburden is glacial till. Up to 5 feet of muck was probed in the saddles. The underlying outwash deposits consist of 0.5 to 2.0 feet of compact and semi-pervious gray SM soil (15% silt and 10% hard, subangular to subrounded gravel) over compact and pervious SP-SM and GP-GM soil. (40 - 60% hard rounded gravels to 3 inches, 5% silt and 15% hard, rounded cobbles and boulders to 18 inches). The water level is at or near the surface and the pit walls were caving. In test pit (TP-57) the ground water was a bright iridescent orange color.

The glacial till in the foundation and adjacent borrow areas is an SM and SP-SM soil. It has 10 - 25% hard, subangular gravel to 3 inches and 10 to 15% silt. It is dense and semi-pervious to pervious. It includes up to 25% hard, subangular rocks from 3 to 24 inches.

In the borrow areas, oversize material includes hard, subangular to subrounded rock as follows:

5%	3" - 6"
5%	6" - 12"
10%	12" - 24"

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-122	DRAWING NO. SHEET 12 OF 12 DATE

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COMMENTS AND CONCLUSIONS

1. Sample 211.1 and the correlation samples (namely: 4.1, 59.1, 207.1 and 221.1) represent our fill material and most of the overburden at the site. This material is relatively dry (4.6% moisture), somewhat cemented and difficult to excavate. It includes hard, subangular to subrounded rocks as follows:

3%	3" - 6"	
2%	6" - 12"	
1%	12" - 18"	plus occasional larger boulders

This soil in-place is dense and semi-pervious. Most of the cobbles and boulders are near the surface.

2. Surface boulders in the borrow and emergency spillway area total:

53 cubic yards per acre	6" - 18"
311 cubic yards per acre	18" - 36"

3. Surface boulders elsewhere on the site total:

35 cubic yards per acre	6" - 18"
173 cubic yards per acre	18" - 36"

4. There is also 4,250 cubic yards of boulder rock excavation within the grid survey (*See drawing sheets 2 and 3*).

5. Core material and quality drain fill materials in sufficient quantity are not available on site or within reasonable distance of the site.

AT THE DAM

6. Sample 7.1 represents the overburden in the high "topo" feature that crosses the right abutment.

7. Sample 211.1 is similar to the overburden in the high "topo" feature along the left abutment. Sample 503.2 represents a very pervious inclusion in an otherwise semi-pervious abutment.

8. The foundation is wet except for the high ground along the centerline.

9. There is up to 6.5 feet of muck across the low area in the foundation. The bedrock surface is very irregular in this area. There is some 10 feet of near vertical relief on the bedrock surface. There are outcrops and bedrock was cored at depths of up to 19 feet.

10. The overburden across the low area is thick and variable in type, strength and permeability. Some strata within this outcrop are observed

to be very pervious. The most pervious material is the "open-work" cobbles and boulders (See TP-5 from 2 to 5 feet). Sample 506.1 represents the finer gradation of the variable outwash.

11. The bedrock has overall adequate "in-place" strength. Leakage rates through the bedrock are minor or insignificant.

DIVERSION AREA

12. There are many surface boulders. The overburden is generally shallow. Sample 1..1 represents most of this material. The water level is at or a few feet above the hard bedrock surface.

13. Sample 902.1 represents a limited area of pervious, coarse-grained soil.

BORROW AND EMERGENCY SPILLWAY AREA

14. The topographic map of the bedrock is contoured to the top of the bedrock surface. A small amount of this rock, as in TP-211 (5 to 9 feet) and DH-[illegible] (10 to 18 feet), can be excavated as earth.

15. Additional borrow is available to the west of this area (See TP's -102, -201, -202).

16. The pegmatite and Oliverian granite are obviously durable rocks. The schistose rock is a non-durable, soft, degradable rock. These rock types can be selected or rejected for use as riprap by field examination.

17. The selection or rejection of the biotite gneiss for use as riprap will present problems as noted:

(a) Where granitized, it has the hardness and durability of the granite.

(b) Elsewhere it is hard and granular with friable surfaces or decomposed to some depth (4' in TP-211, 3' in TP-901, 5' in TP-[illegible]).

Abrasion and soundness tests may assist in the determination of suitability for riprap.

ADDITIONAL BORROW AREA

18. The high knob centered at DH-15 is a good source of fill. More borrow is available to the west of this area (See TP's -151 and -152). The material is represented by sample 4.1. It correlates to the fill material (See item 1).

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-124	DRAWING NO. SHEET 11 OF 15 DATE

DIKE

19. Aside from the two low saddles, the foundation and borrow soils are represented by sample 53.1 and 52.1. This overburden is generally semi-pervious and dense. It correlates to the fill material (See item1).

20. Up to 5 feet of muck was probed in the low, wet saddles. Beneath the muck there is up to 2 feet of compact and semi-pervious silty sands (Sample 53.1) over compact and very pervious, gravels and sands (Sample 52.1) with 15% hard, rounded cobbles and boulders to 18 inches.

21. The depth to bedrock is an assumed depth in this area and the thickness of the outwash is unknown.

FOR IN SERVICE USE ONLY

ENGINEERING INTERPRETATIONS, RECOMMENDATIONS AND CONCLUSIONS

General

The structure, a multiple-purpose flood control - recreation dam, is located in a large basin on the northerly side of Jericho Brook, in Berlin, New Hampshire.

Centerline of Dam

Various centerline of dam locations have been studied. A centerline along the high topographical features, as proposed in planning, would probably require the least amount of fill; but this particular centerline would propose difficulty during construction due to the number of angles required for layout along the high features.

The demonstrated centerline was chosen for the following reasons:

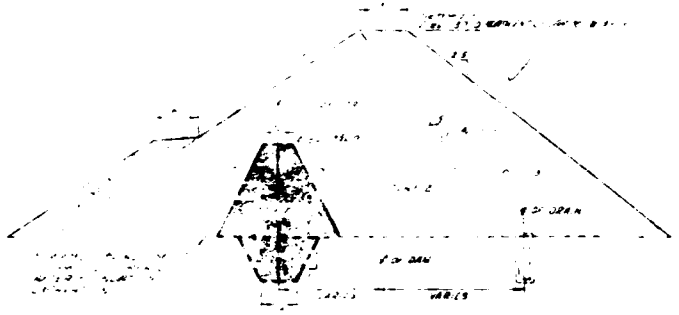
1. On the left abutment, the proposed centerline is located on the upstream side of the high features. By locating the dam upstream of these features, pervious zones, such as found in DH-17 from 15.5 to 20.0 feet, could be cut-off with the blanket effect of the fill against the slope. Also, the pervious zones would be in a more desirable location in the foundation.

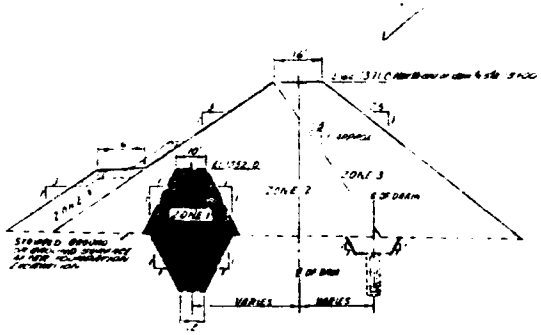
2. The high topographical feature upstream of the centerline in the vicinity of station 25+00 and 0+00 could be used as a source of borrow. This could be excavated to a level that is approximately the elevation of the surrounding swamp. Any stratifications of sand, such as found in TP-4, therefore, would not be in the foundation of the dam.

3. On the right abutment, in the vicinity of station 20+00 and [illegible], the centerline goes through a high feature. Investigation didn't indicate any stratification of pervious sand in the feature. The bulk of the feature lies downstream of the centerline; and if any stratification is present, it would be more desirable having it downstream of the centerline rather than upstream.

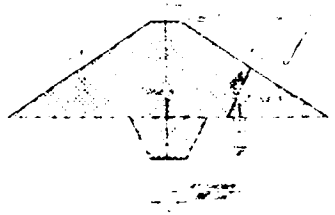
4. With the proposed centerline, there would be a better opportunity to extend the cut-off to bedrock in the area of the high features. This possibility could be further

REFERENCES:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-126	DRAWING NO. SHEET 1 OF 8 DATE [illegible]





TYPICAL SECTIONS OF EMBANKMENT (DAM)



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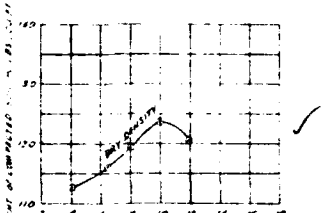


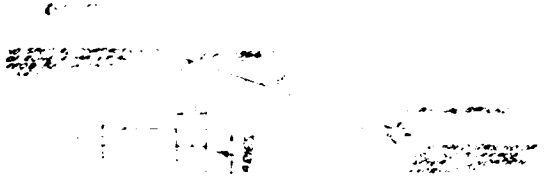
COMPACTION CURVE (ASTM D-698)
FIELD SAMPLE NO. 71
LABORATORY CLASSIFICATION SC-SM

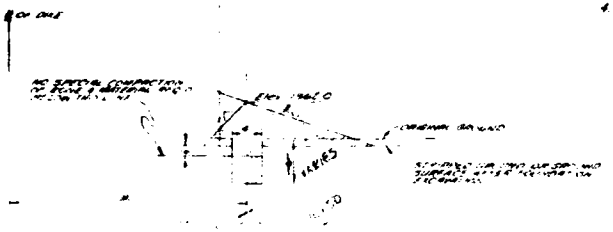
EARTH FILL REQUIREMENTS

ZONE NO	MATERIAL	MAX. PARTICLE SIZE	MAX. LIFT THICK.	WATER CONTENT	COMPACTION CLASS	COMPACTION DESCRIPTION
1	SILTY SANDS (SM) AS ALTERNATIVELY THE "OB" OF TP-21 FROM 1' TO 11' BORROW AREA B	6"	9"	OPTIMUM to OPTIMUM + 4%	A	95% OF MAX. DENSITY, BY AS TM D 698, METHOD A
2 & 2A	SANDS WITH FINES (SP-SM) AS REPRESENTED BY TP-20(1) FROM 7'TO 14', TP-20A FROM 1'TO 13', TP-21 FROM 1'TO 11' BORROW AREA B	6"	9"	WET*	V	SEE SPECIFICATION 3
3	ZONE 2 MATERIAL PLUS OVERSIZE REMOVED FROM ZONE 1*	18"	24"	WET*	V	SEE SPECIFICATION 3
4	GRAVELLY SANDS (GW-GM) AS REPRESENTED BY TP-22 FROM 5'TO 7' & TP-23 FROM 3'TO 10'	12"	16"	WET*	V	SEE SPECIFICATION 4
5	SANDS WITH FINES (SP-SM) AS REPRESENTED BY TP-19(1) FROM 4'TO 5' (TOP) FROM 3'TO 7' BORROW AREA D	12"	16"	WET*	L	SEE SPECIFICATION 5

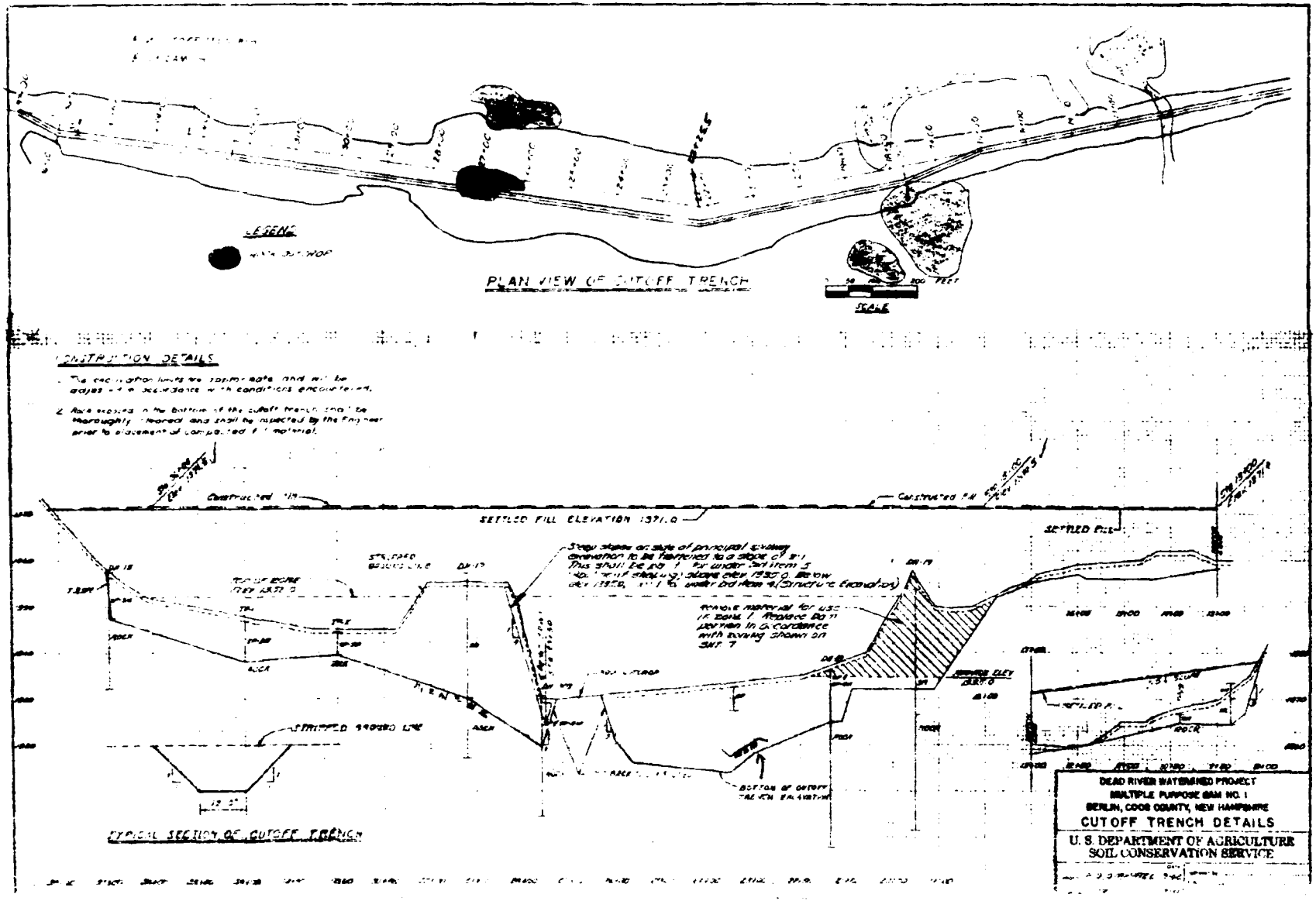
NOTES:

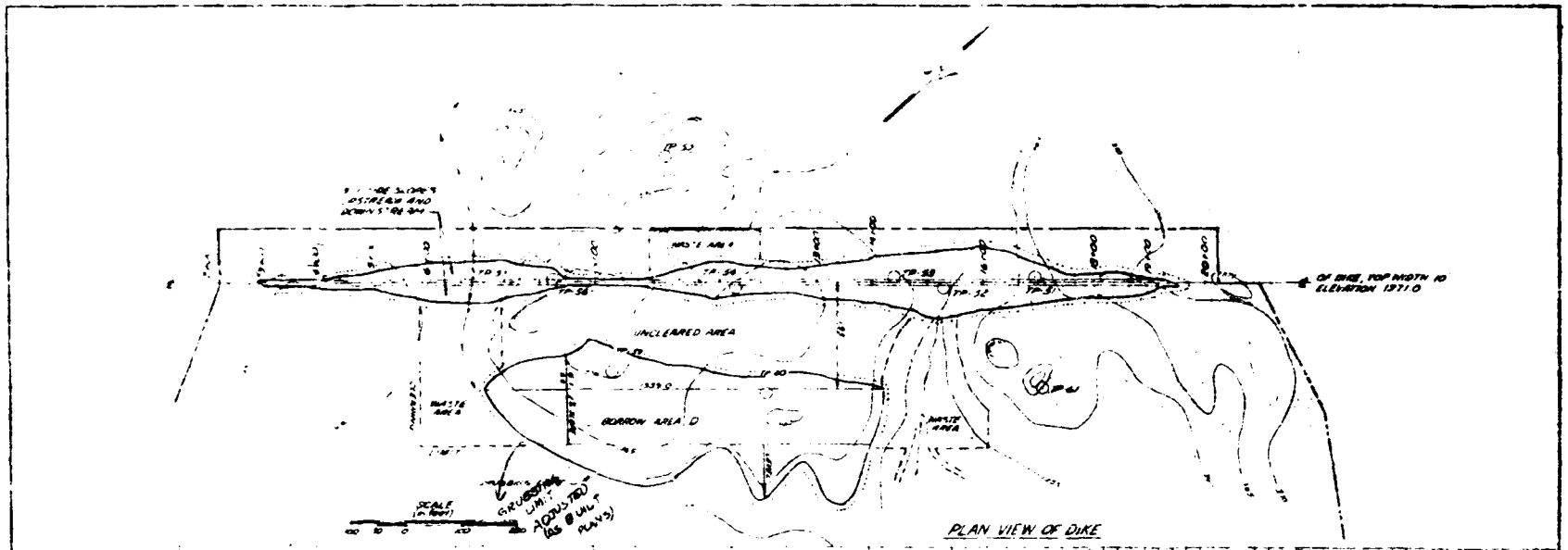
1. Maximum lift thickness is before compaction.
2. For fill adjacent to structures, maximum rock size is 3".
3. All fill to be selectively placed. The relative size of zones 3, 4 & 5 to be determined by the engineer.
4. * Thoroughly wet, but not so wet as to cause displacement of the soil, to wheels or tracks of equipment nor to cause bogging down of equipment.

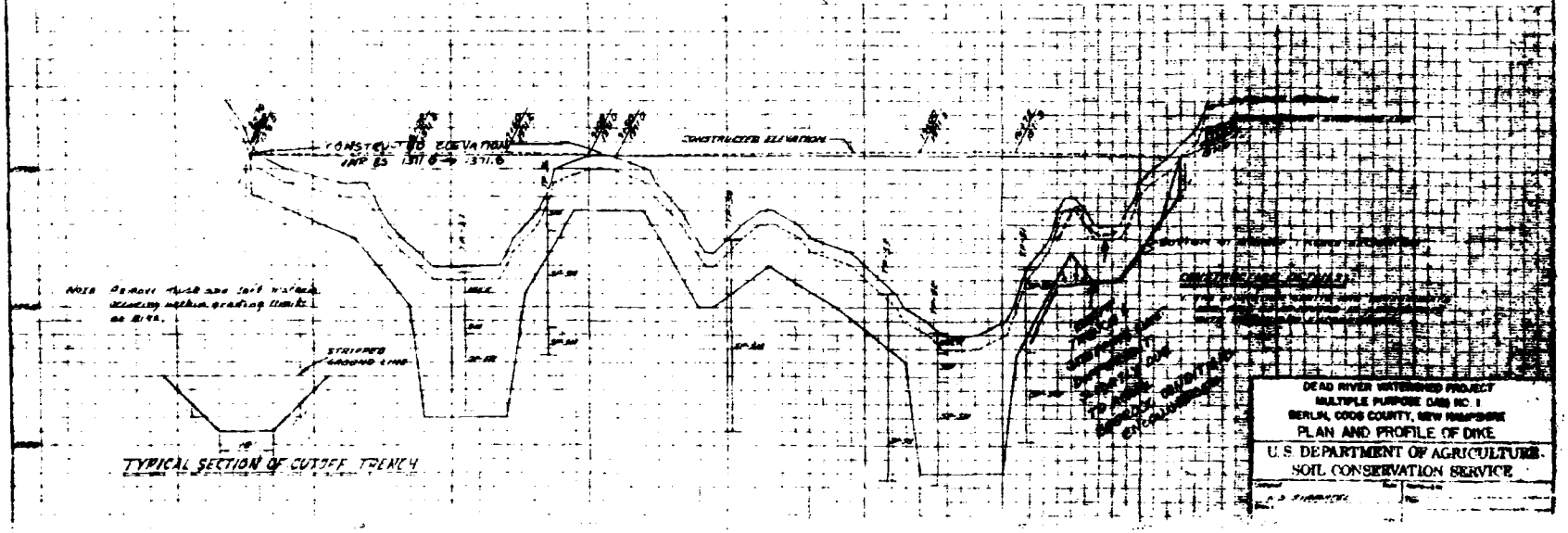




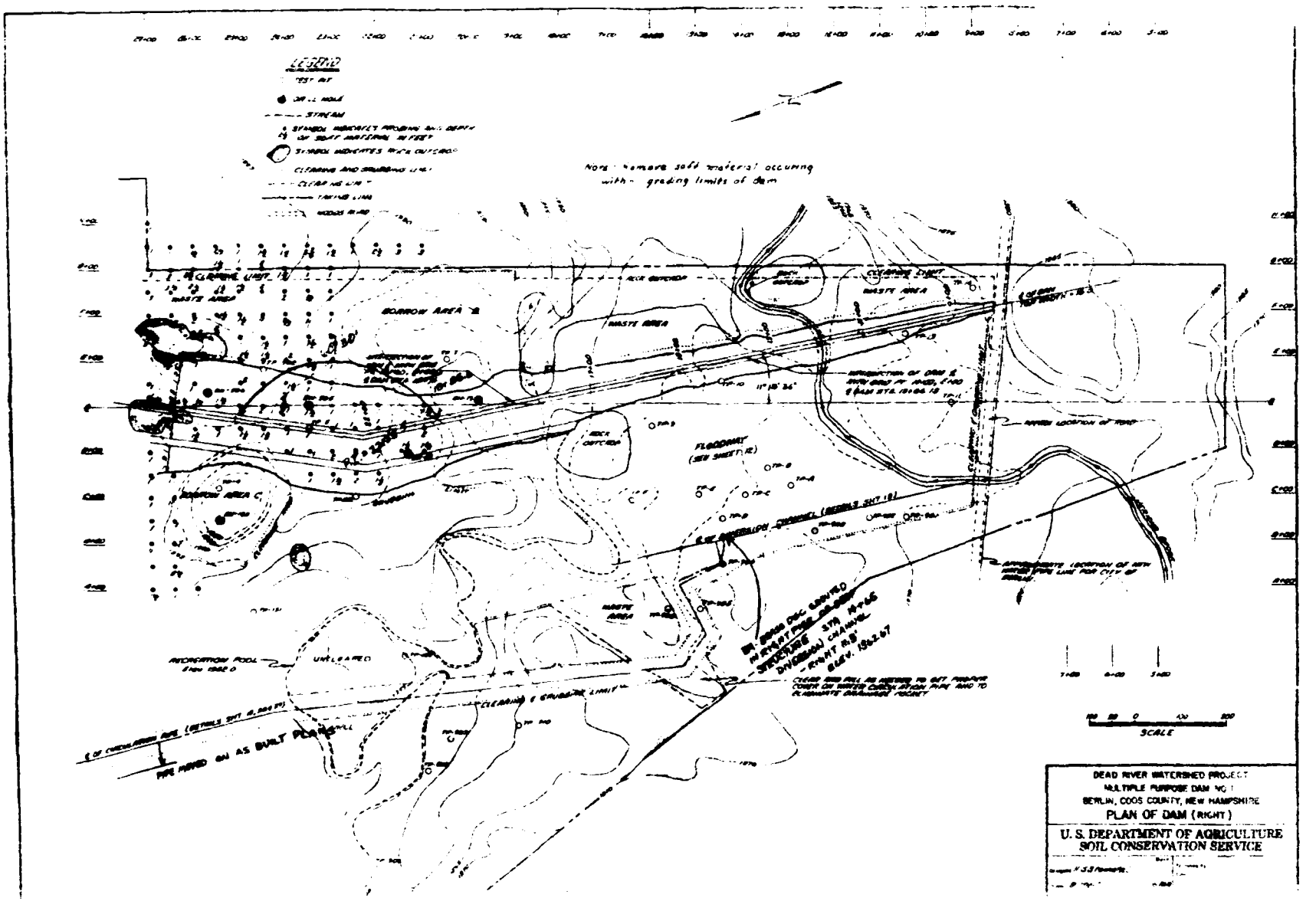
DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
FILL PLACEMENT
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

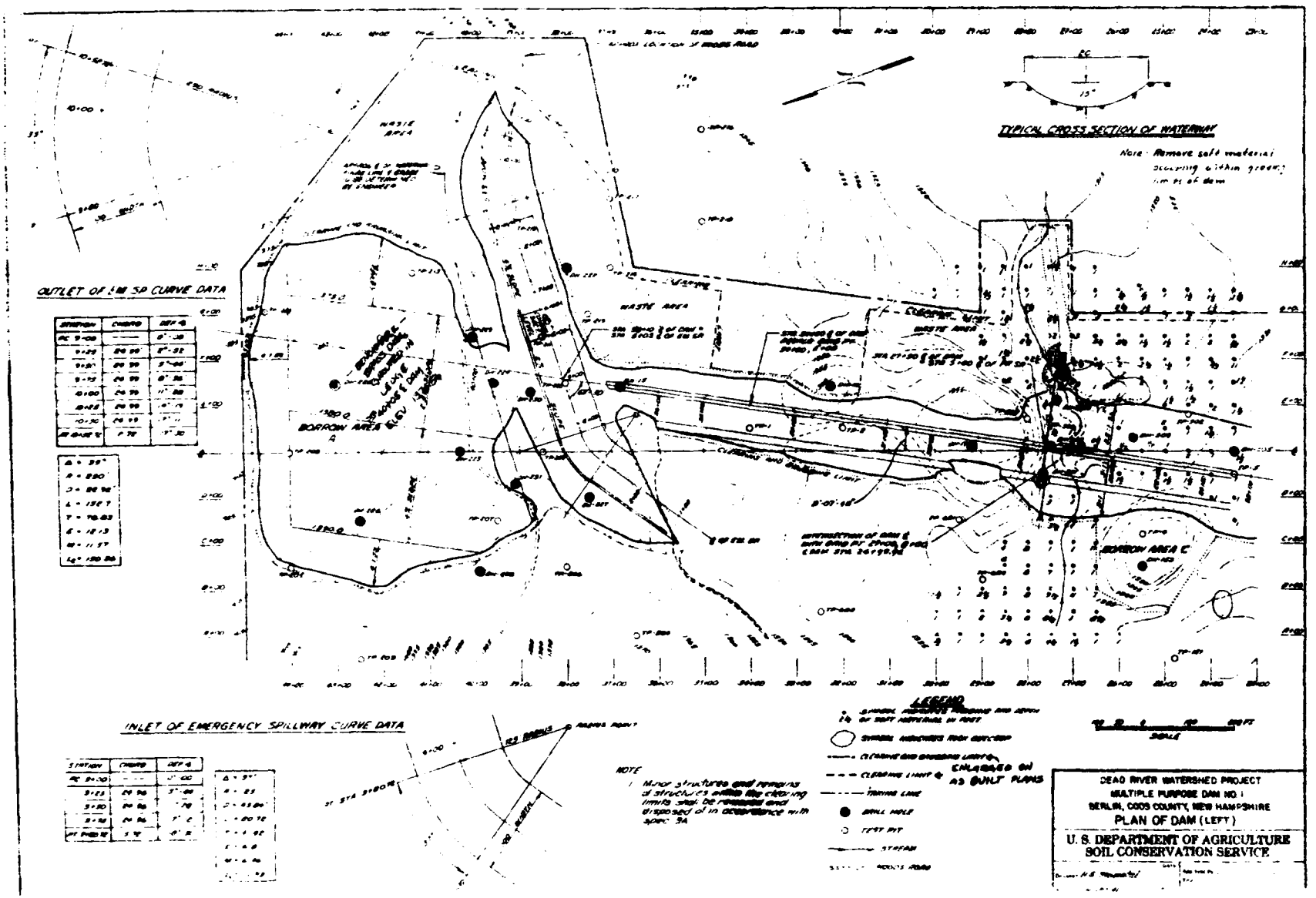

PLAN VIEW OF CUTOFF TRENCH
SCALE
CONSTRUCTION DETAILS
SETTLED FILL ELEVATION 1371.0
TYPICAL SECTION OF CUTOFF TRENCH
DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
CUTOFF TRENCH DETAILS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

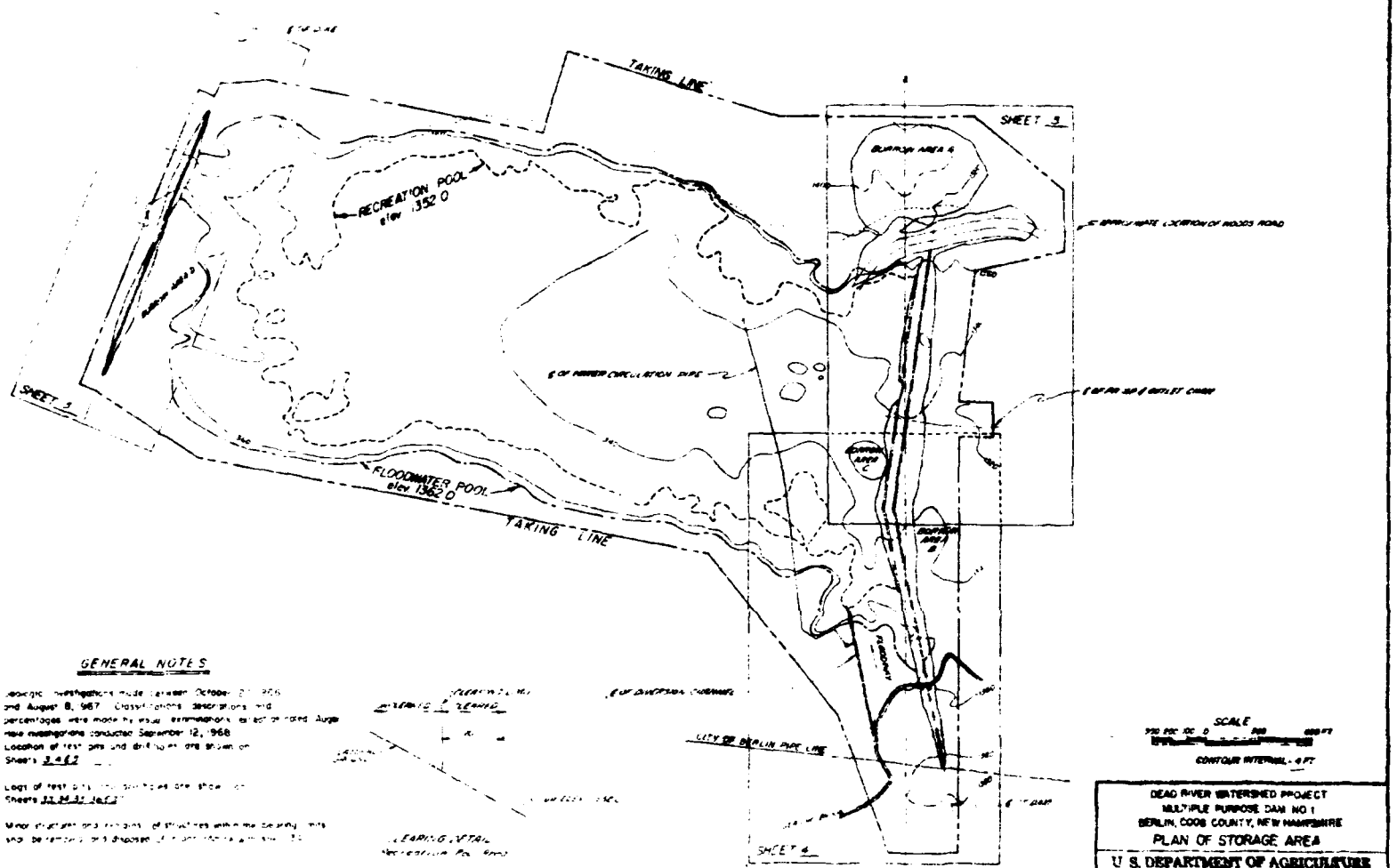




DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
PLAN AND PROFILE OF DIKE
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE


Note: remove soft material occuring within grading limits of dam
BORROW AREA "B"
WASTE AREA
FLOODWAY
(SEE SHEET 12)
SCALE
DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
PLAN OF DAM (RIGHT)
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE


TYPICAL CROSS SECTION OF WATERWAY
OUTLET OF SW SP CURVE DATA
INLET OF EMERGENCY SPILLWAY CURVE DATA
BORROW AREA C
LEGEND
NOTE
DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
PLAN OF DAM (LEFT)
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



GENERAL NOTES

1. Geologic investigations made between October [illegible] and August 8, 1967. Classifications, descriptions and percentages were made by visual determinations of test pit and auger hole investigations conducted September 12, 1968.
2. Location of test pits and drill holes are shown on Sheets 3 & 4.
3. Logs of test pits and drill holes are shown on Sheets 33, 34, 35 & 36.
4. Minor changes in the location of structures within the reservoir area shall be permitted as the design progresses.

DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
PLAN OF STORAGE AREA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DEAD RIVER WATERSHED PROJECT

MULTIPLE PURPOSE DAM NO. 1

DRAINAGE AREA	4147 ACRES
FLOOD STORAGE (EMERGENCY SPILLWAY FLOW)	559 ACRE FT
WATER SURFACE AREA (AT ELEVATION OF)	132 ACRES
HEIGHT OF DAM	46 FEET
VOLUME OF FILL	~~269,500~~ 13,705 CUBIC YARDS AS-BUILT

BUILT UNDER THE WATERSHED PROTECTION AND FLOOD PREVENTION ACT

by

COOS COUNTY SOIL CONSERVATION DISTRICT,
CITY OF BERLIN, NEW HAMPSHIRE

and the

NEW HAMPSHIRE WATER RESOURCES BOARD

with assistance of

U S DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

1968

REPRODUCED AT GOVERNMENT EXPENSE

INDEX

DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
COVER SHEET

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

turn over of the water throughout the site if the Jericho Brook base flow is allowed to enter the recreation pool in the vicinity of the principal spillway. To lessen such a potential short circuiting, flows as large as possible will be diverted into the reservoir as far upstream as is feasible.

It is quite probable that this water quality diversion will be a small pipe or channel conducting flow from Jericho Brook to a point well upstream of the dam.

Arthur P. Luktala

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-133	DRAWING NO. SHEET 8 OF 8 DATE 12/26/77

The dike will be subject to small heads during flood times and no head during normal conditions. It is anticipated that no unusual design measures are required.

The only foundation treatment required appears to be the removal of the muck encountered in the two saddles.

A cut-off will be excavated 3 or 4 feet into the ground to penetrate through the zone of frost action.

Drainage measures are expected to be accomplished by selective placement. Outwash material from the saddles and the coarsest of the borrow materials will be placed in a downstream blanket zone. In the saddles and low areas, where the dike is subject to the greatest head, oversize rocks can be wasted on the downstream face and toe of the structure.

Proposed side slopes for the dike are 3:1 both upstream and downstream.

Adequate borrow material is available for construction of the dike from the high topographical features located both upstream and downstream of the centerline. It is important that any of these areas used are dressed and neatly graded and provided with positive drainage because of the recreation involved.

Legal complications preclude diverting waters from one watershed to another. Therefore, the use of this saddle for an emergency spillway will not be allowed.

Jericho Brook Diversion

This diversion is primarily required to divert a major portion of Jericho Brook into this relatively economical site.

Test holes, surface outcrops and the irregular topography indicate that the diversion will involve rock excavation.

Studies are being made to determine the most economical method to accomplish the diversion. The varying rock depth and irregular rock surface complicates these studies.

The final solution is expected to be a wide floodway involving some rock excavation along with some diking and riprapping measures.

Since this structure is to be used for multi-purpose recreation, it is imperative that the water quality be adequate for [illegible]. One question exists whether there will be sufficient

If the quantity of oversize is adequate, a zone of riprap on the lower upstream face of the dam will be called for. A zone of this nature, particularly on the right abutment where the dam also serves as a dike for the Jericho Brook diversion, would keep the face of the slope from eroding during flood flows. Bedrock excavated from the emergency spillway could be used as riprap. The quantity of oversize material appears large enough so that any excess rock not used as riprap will be considered for use in a fill zone containing oversize material up to 18", or as a rock fill.

Due to the expansive pool area and the easterly trend of the valley, the prevailing west winds would make the dam vulnerable to wave action. A zone of riprap would help in stabilizing the upstream slope of the dam.

Proposed side slopes for the dam are 3:1 upstream and $2\frac{1}{2}$:1 downstream.

The primary borrow source is the emergency spillway area. The emergency spillway excavation (35,000 c.y.) will not provide sufficient borrow, so the area adjacent to the spillway will be used for borrow. From the recreation aspect, it is important that the area be sloped, neatly dressed, and provided with positive drainage.

The high topographical feature located upstream of the centerline in the area to the right of the principal spillway will be used as a source of borrow. It will be excavated to some predetermined elevation well below recreation pool level.

The area west of the high feature was investigated as a borrow source. The overburden was relatively rocky and somewhat thin in places.

The Jericho Brook diversion will be another source of borrow materials. These materials will be used in any necessary diking to contain flows in the water quality circulation system, or in the dam itself, depending on the volume of the excavations. Such excavation in this area is expected to be small. Rock excavation from this source will be used as riprap.

Dike

A 1,600-foot dike is required on the upper end of the storage basin to prevent flood flows from entering the Ammonoosuc Watershed.

2. Any unsuitable materials in the foundation will be removed particularly in the area of the left abutment from station 31+00 to 37+00.

3. The steep slope on the left abutment next to the principal spillway location should be cut back to an acceptable slope.

Emergency Spillway

The emergency spillway is located on the left abutment. The layout was based on a study of the bedrock contours of the area. An economic study was developed to determine the most economic proportioning of the structure. The study shows a spillway with a 100-foot bottom width, a crest elevation of 1362.0, and a top of dam elevation of 1371.0 to be the most economical layout.

The emergency spillway layout does not yield sufficient fill to construct the dam. It will be necessary to go to a borrow area for additional fill. The rock excavated from the spillway will be used for riprap as required.

The control section will bottom on bedrock. The side slopes proposed are 1:1 in rock and 4:1 in earth.

An additional safety factor has been provided. The emergency spillway crest was set one foot above the elevation required for a 100-year long-duration storm. This reduced the amount of rock excavation and still left the control section on bedrock.

The emergency spillway outlets into a drainage way that enters the stream approximately 2,000 feet below the structure. Therefore, flowing water in the emergency spillway will not impinge on the dam.

The profile of the emergency spillway is such that it provides maximum fall. The exit channel is directed away from the structure and a considerable distance downstream before discharge is permitted on natural relief.

Embankment and Borrow Areas - Dam

All of the available borrow, from the emergency spillway and borrow areas, appears to be homogeneous.

It appears as if more compactive effort could be used in a core zone because of the lack of good quality core material. The shell zones could be designed to incorporate oversize materials in the 6-12 inch range.

required. Material for such a drain would undoubtedly have to come from materials located off site.

It may be possible to relieve the pervious zone found in DH-17 from 18.5 to 20.0 by tapping into that strata with a trench if it is encountered during foundation excavations.

The approximately 5,000 cubic yards of GP-GM material as found in TP-604 might be considered a useable pit run blanket material in the low area (station 22+00 to 28+00).

The geologist has indicated that leakage through bedrock is minor.

Other factors to be considered in drainage design are as follows:

1. Sand and gravel of significant quantity and quality are not available on site or within close proximity (except as noted above).

2. The closest source of pit run sands and gravels occurs in the Dead River Valley adjacent to NH Route 110, approximately 4 miles away.

Principal Spillway

The principal spillway location is proposed at the base of the high feature on the left abutment. This appears to be the best location. By moving the alignment to the left into the slope, a sizeable excavation will be required. Moving the alignment to the right would result in bridging the two outcrops of bedrock which would be undesirable. Moving the alignment to a location where the pipe would be all on bedrock would not allow a pond drain system without excessive excavation of rock.

It appears that a cantilevel outlet with a plunge pool will be the appropriate energy dissipator for the pipe outlet. If bedrock is encountered in the plunge pool, it will be blasted out to the required grades.

Foundation Treatment - Dam

1. Any muck in the foundation area of the dam will be excavated to a suitable material prior to the placement of any fill. It will be important during construction to see that excavation includes muck around nested boulders and bottoms out on a firm material.

From the high feature on the right abutment to Jericho Brook a cut-off can be extended to bedrock with shallow cuts of 0 to 7 feet.

Drainage - Dam

Stratification of the water-worked till and the perviousness of the alluvium outwash indicates the need for drainage measures.

On the left abutment from DH-15 toward the high features, bedrock could be reached with a standard trench drain. In the area of the high "topo," bedrock is over 20 feet deep as indicated by DH-16 and DH-17. To what depth should a trench drain be extended in the area of these features? A pipe collector could be installed and outleted in the drainage way, between the high features, in the vicinity of station 31+00.

At the base of the high feature, in the area of the principal spillway, a trench could be extended around the toe, beyond the embankment, to intercept any stratifications or lenses present.

In the flat area between the base of the abutments, the outwash is up to 19 feet deep as indicated by DH-505. A pipe collector drain is recommended in this area. A blanket drain may also be necessary if the embankment material is not compatible with the foundation material.

Openwork cobbles and boulders are described as representing portions of the overburden in this area. What measures should be taken in the design and construction phases if it is anticipated that they present a serious problem?

The foundation in this area appears as if consolidation will present no problem.

With the foundation being so pervious and ground water at the ground surface, it is expected that dewatering to an elevation close to bedrock will be extremely difficult. To what depth should a trench be extended across this area? Should any other special measures be taken in this area?

The high feature investigation by DH-19 shows 27 feet of overburden. To what depth should the trench be extended in the area of deep overburden?

Because the fill is generally homogeneous, and there is some question as to obtaining a downstream shell zone significantly more permeable than the core zone, a chimney drain may be

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE B-128	DRAWING NO. SHEET 3 OF 8 DATE 12/26/47

increased if the cut-off were placed upstream of the centerline.

5. Having only one angle in the dam would simplify construction.

Cut-off - Dam

The fact that this structure is a multiple-purpose recreation dam, with a 155-acre lake and a maximum depth of 25 feet, would indicate the need for a cut-off.

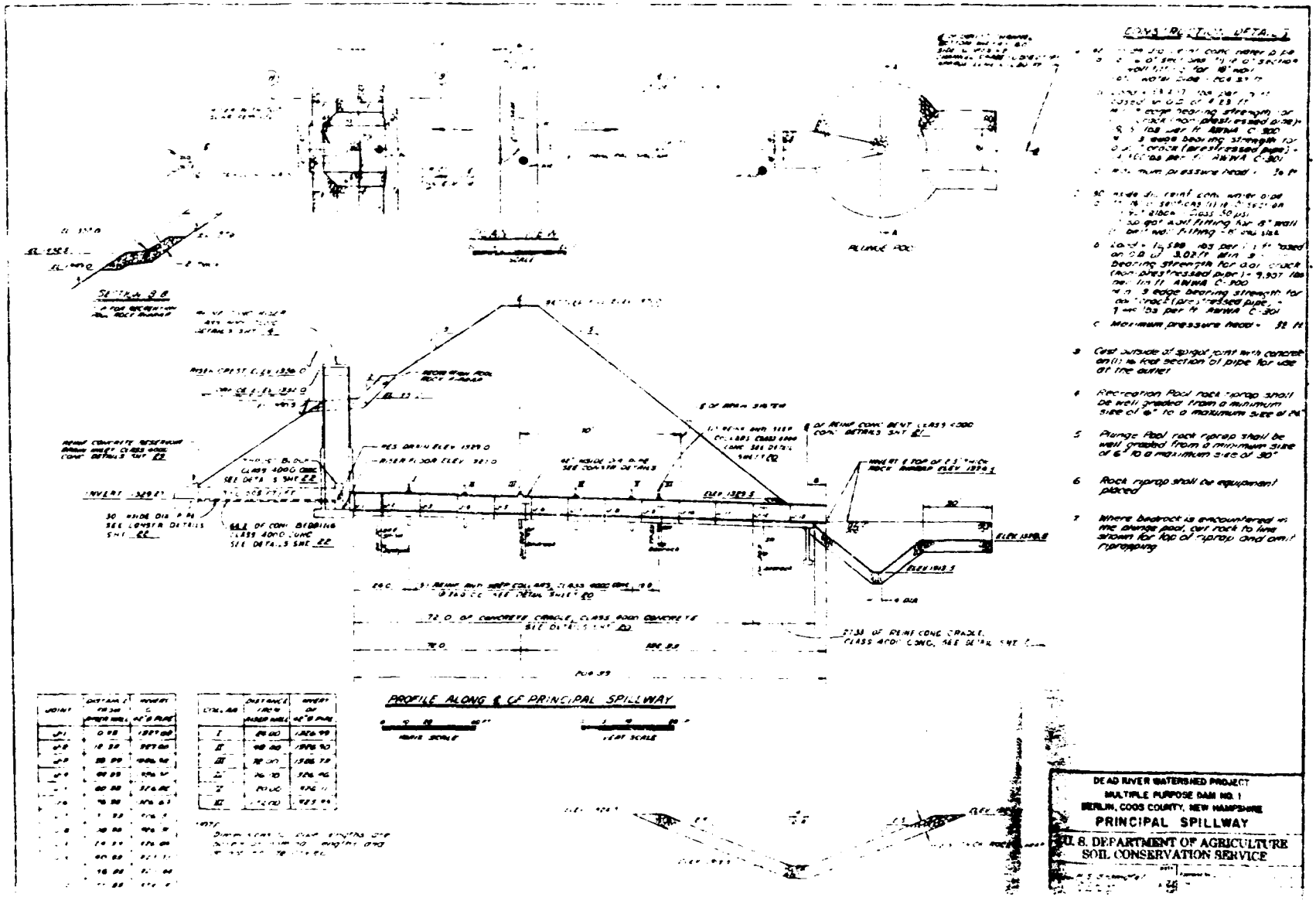
A cut-off will disclose and obstruct any stratifications or lenses found in the water-worked till of the foundation. A good quality core material is not available on site, so any cutting off will have to be accomplished with the available soils on site.

It appears as though an upstream cut-off can be extended to bedrock on the left abutment with cuts of 10 feet or less until you reach the high feature near the stream. In this particular feature, bedrock is 27 feet deep as indicated by DH-17. It is not believed necessary to extend the cut-off to bedrock in this area. Possibly extending it 10 feet or so to lengthen the flow path would be adequate. A blanket could be placed on the face of the slope and extended some distance upstream if necessary.

In the area of the principal spillway, bedrock was encountered from 5 to 11 feet. Some of it was highly weathered and easily excavated with a backhoe. It is anticipated that zones of weathered rock carrying much water will be removed. To the right of the principal spillway there is an outcrop of bedrock, indicating some sharp relief in the bedrock surface.

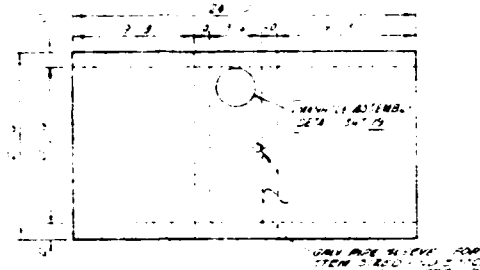
Across the foundation area, between the base of the abutments, bedrock was encountered from 0-11 feet upstream of the centerline. It appears that a positive cut-off can be realized. Ground water is at the ground surface in much of this area, so it is expected that water will be a major problem during construction.

The high feature near the base of the right abutment, bedrock at 27 feet as indicated by DH-17. To what depth should the cut-off be extended in this area? DH-19 and TP-7 indicate this to be very dense and impervious. A depth of 5 feet to penetrate the surface zone may be adequate for cut-off.

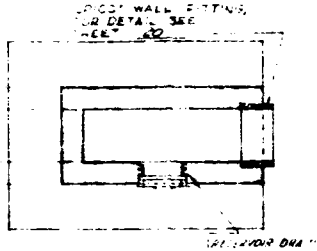


PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY

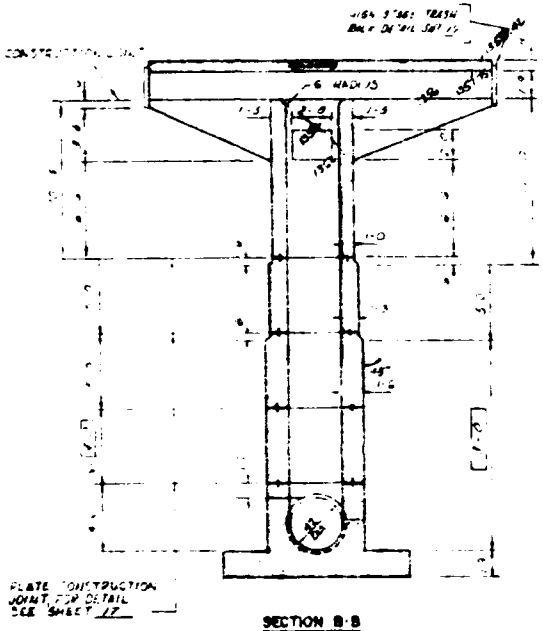
DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE
PRINCIPAL SPILLWAY
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



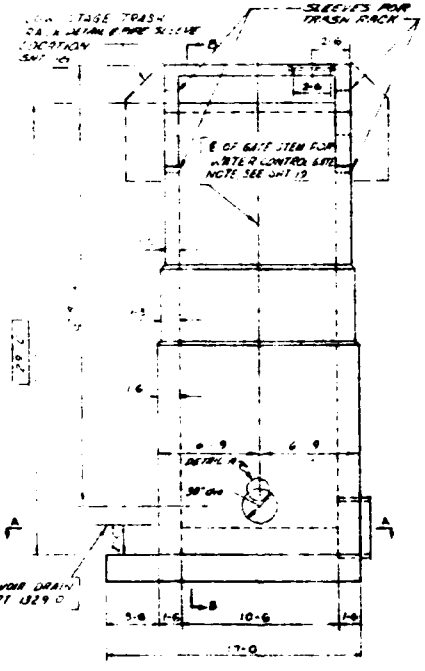
TOP PLAN



SECTION A-A



SECTION B-B



SIDEWALL ELEVATION

STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	6	16	12-0	1	-	-	216-0
B2	6	18	4-6	1	-	-	81-0
B3	6	18	4-0	1	-	-	72-0
B4	6	30	12-0	21	8-5	7-9	600-0
B5	6	15	16-6	1	-	-	247-6
B6	6	17	12-0	1	-	-	204-0
B7	6	4	5-4	1	-	-	21-4
B8	6	6	5-6	21	1-0	7-8	33-0
B9	6	4	9-8	21	1-0	7-8	38-8
B10	6	28	5-6	21	1-0	7-8	154-0
B11	6	2	8-8	21	1-0	7-8	17-4
B12	6	92	8-6	1	-	-	782-0
B13	6	8	8-6	1	-	-	72-6
B14	6	30	11-6	21	8-7	7-7	333-6
B15	6	4	9-2	21	8-7	7-7	36-8
B16	6	4	9-10	21	8-7	7-7	39-4
B17	6	6	8-7	21	1-0	7-7	51-6
B18	6	2	10-2	21	8-7	7-7	20-4
B19	6	2	9-3	1	-	-	18-6
B20	6	2	2-8	1	-	-	5-4
B21	6	2	2-10	1	-	-	5-8
R1	6	20	11-0	1	-	-	220-0
R2	6	8	11-0	1	-	-	88-0
R3	6	26	9-6	1	-	-	247-0
R4	6	12	5-6	1	-	-	102-0
R5	6	12	11-6	1	-	-	138-0
R6	6	8	4-6	1	-	-	36-0
R7	6	33	11-6	21	4-7	7-7	379-6
R8	6	10	11-6	1	-	-	115-0
R9	6	10	8-6	1	-	-	85-0
R10	5	56	11-8	21	9-11	7-9	668-0
R11	6	36	2-8	1	-	-	102-0
R12	6	72	2-8	1	-	-	204-0
R13	6	4	10-10	21	3-8	7-2	43-8
R14	6	20	6-11	1	-	-	138-8
R15	6	6	6-11	1	-	-	41-6
R16	6	36	3-6	1	-	-	117-0
R17	6	12	4-6	1	-	-	54-0
R18	5	16	11-2	1	-	-	178-8
R19	6	10	4-6	1	-	-	45-0
R20	5	36	10-10	21	3-8	7-2	804-6
R21	6	28	4-4	1	-	-	112-8
R22	6	8	6-4	1	-	-	44-8
R23	6	4	10-4	21	3-8	6-11	41-4

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T1	6	4	10-0	1	-	-	40-0
T2	5	8	12-8	1	-	-	100-0
T3	5	3	11-6	1	-	-	34-6
T4	6	2	8-0	1	-	-	16-0
T5	5	2	5-0	1	-	-	10-0
T6	5	2	9-6	1	-	-	19-0
T7	5	3	29-6	1	-	-	89-0
T8	5	4	12-6	19	1-6	1-6	50-0
T9	5	4	2-9	1	-	-	11-0
T10	5	4	3-5	1	-	-	14-0
T11	5	4	2-9	1	-	-	11-0
T12	5	4	4-3	1	-	-	17-0
T13	5	4	8-3	1	-	-	33-0
T14	5	4	5-3	1	-	-	21-0
T15	5	4	5-9	1	-	-	23-0
T16	6	4	10-9	1	-	-	43-0
T17	6	10	18-6	1	-	-	185-0
T18	5	56	10-6	2	3-6	2-11	578-8
T19	5	2	11-6	1	-	-	23-0
T20	5	2	13-6	1	-	-	55-0
T21	5	4	23-0	1	-	-	14-0
T22	5	4	12-6	19	1-6	2-3	50-0
T23	5	4	2-9	1	-	-	11-0
T24	5	4	3-3	1	-	-	13-0
T25	5	4	3-9	1	-	-	15-0
T26	5	4	4-3	1	-	-	17-0
T27	5	4	4-8	1	-	-	19-0
T28	5	4	5-3	1	-	-	21-0
T29	5	4	5-9	1	-	-	23-0
T30	5	4	8-0	1	-	-	16-0
T31	5	53	11-6	1	-	-	525-6
T32	5	8	33-6	1	-	-	211-0
T33	6	6	10-8	1	-	-	64-0
T34	5	2	10-8	2	2-3	0-3	20-10
T35	5	2	3-0	21	2-6	0-10	6-0
T36	5	64	3-0	21	2-6	0-10	192-0
T37	4	4	58-0	1	-	-	232-0
T38	4	6	8-0	1	-	-	48-0

QUANTITIES

STEEL

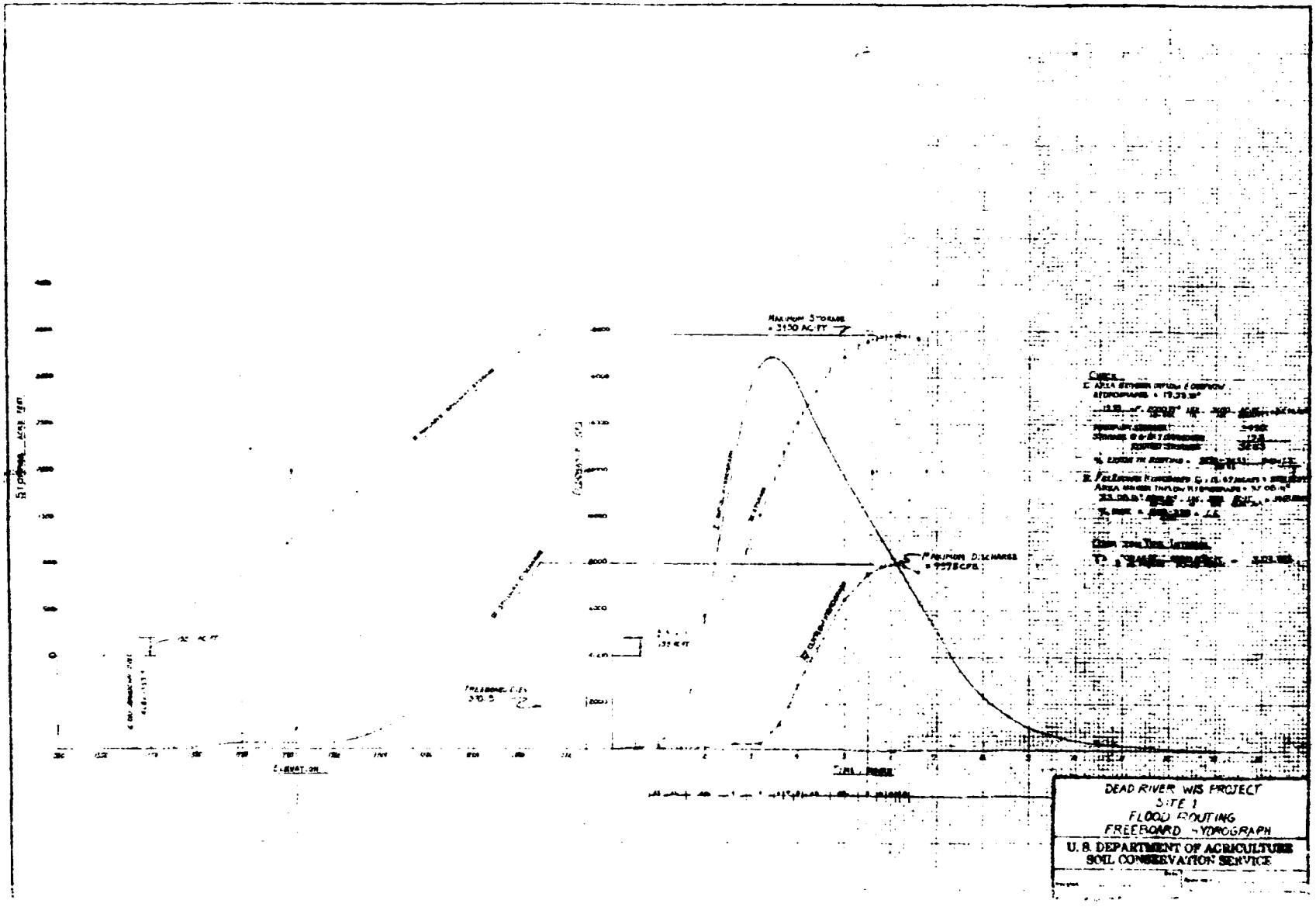
42" DIAM.	1 of 2	780 LBS
36" DIAM.	8 of 2	624 LBS
24" DIAM.	1 of 2	264 LBS

CONCRETE (3,750 PSI) 450 CU. YDS.

DEAD RIVER WATERSHED PROJECT
MULTIPLE PURPOSE DAM NO. 1
BERLIN, COOS COUNTY, NEW HAMPSHIRE

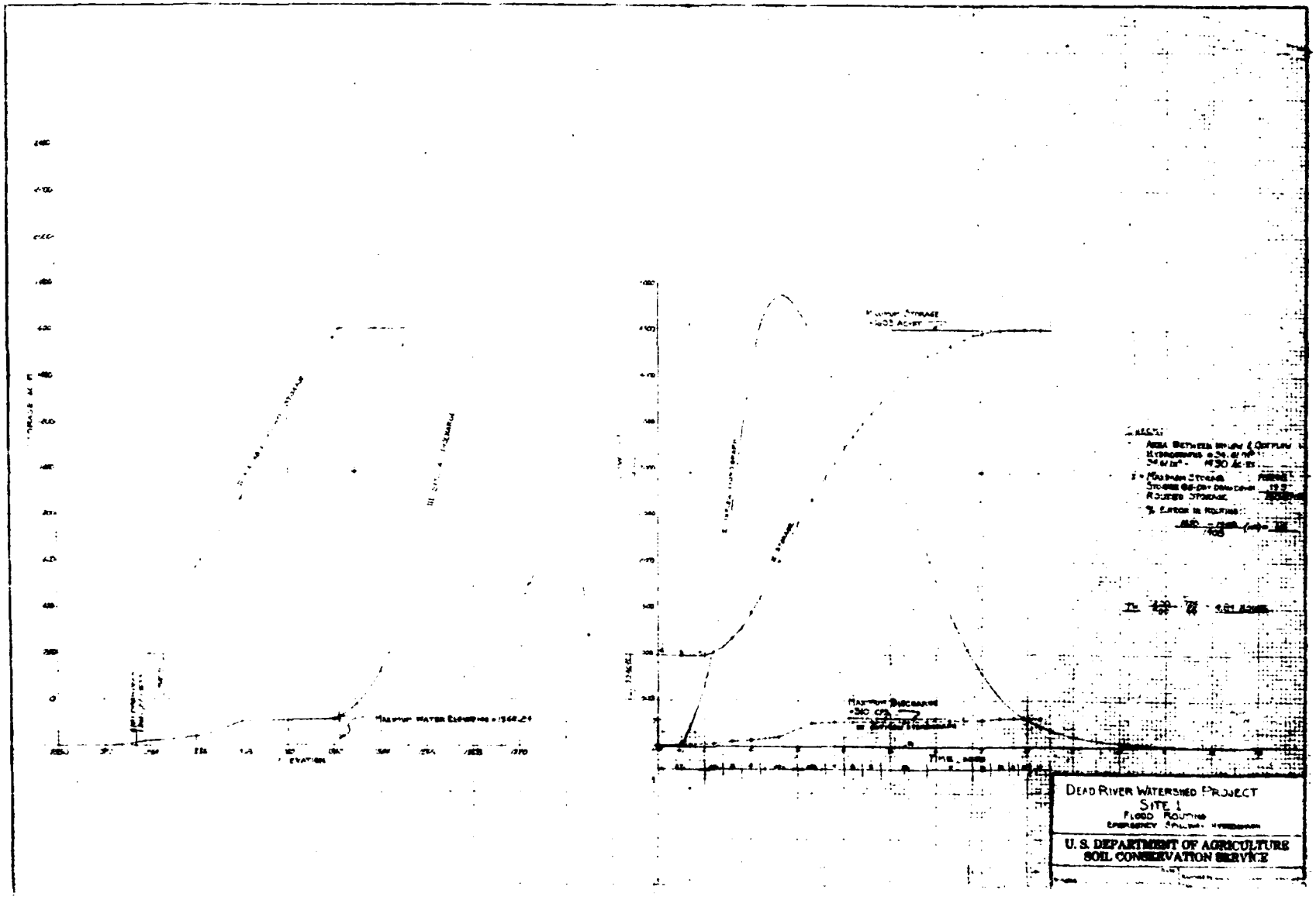
RISER STRUCTURAL DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



DEAD RIVER WIS PROJECT
SITE 1
FLOOD ROUTING
FREEBOARD HYDROGRAPH

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

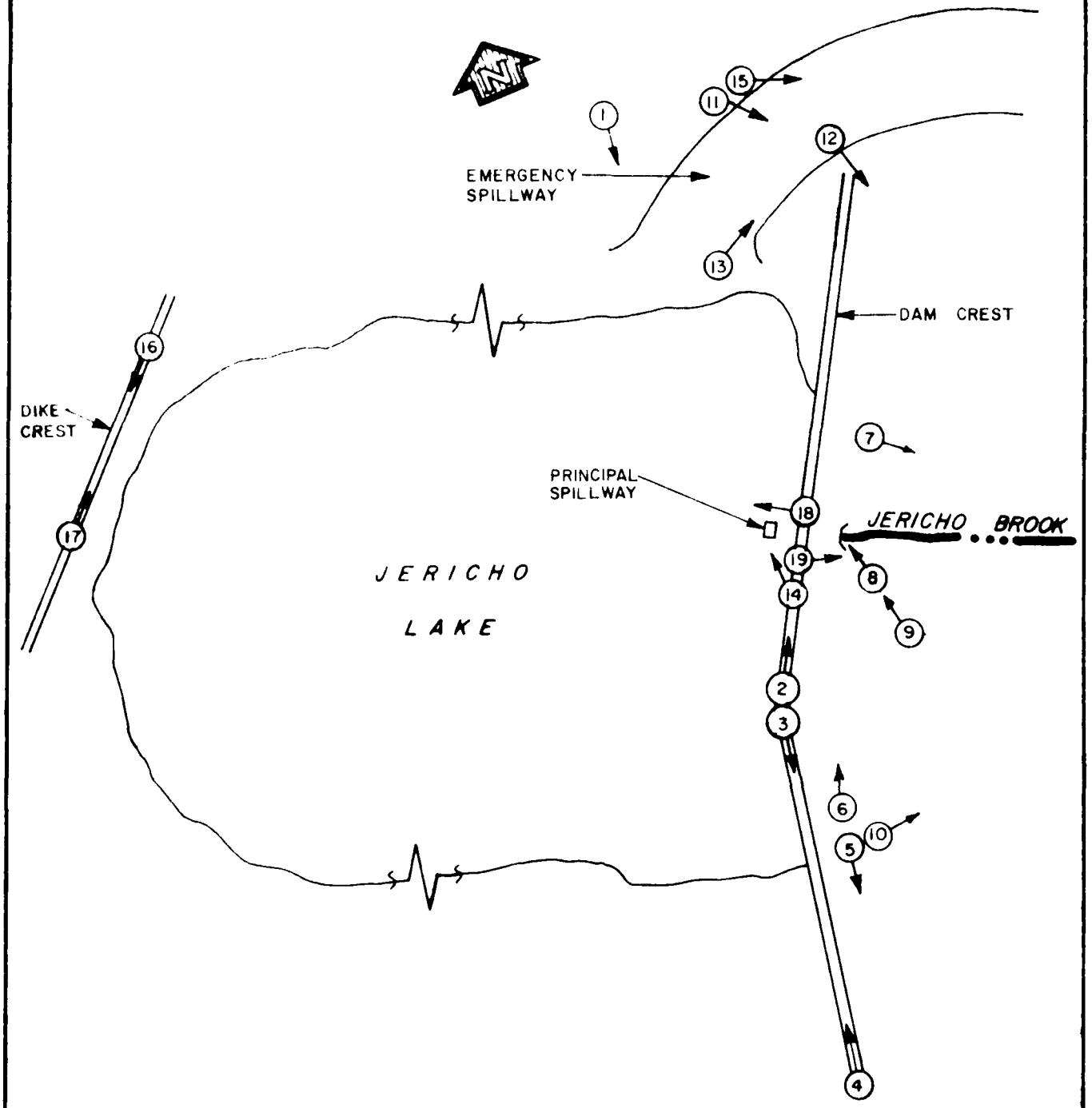


DEAD RIVER WATERSHED PROJECT
SITE 1
FLOOD ROUTING
EMERGENCY SPILLWAY HYDROGRAPH

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SITE NO. 1, DEAD RIVER DAM
PHOTO INDEX

JERICHO LAKE NEW HAMPSHIRE

SCALE: NOT TO SCALE

DATE: JULY, 1979

Figure 2 - Looking north along the top of the dam embankment from the alignment break.

Figure 3 - Looking south along the top of the dam embankment from the alignment break.

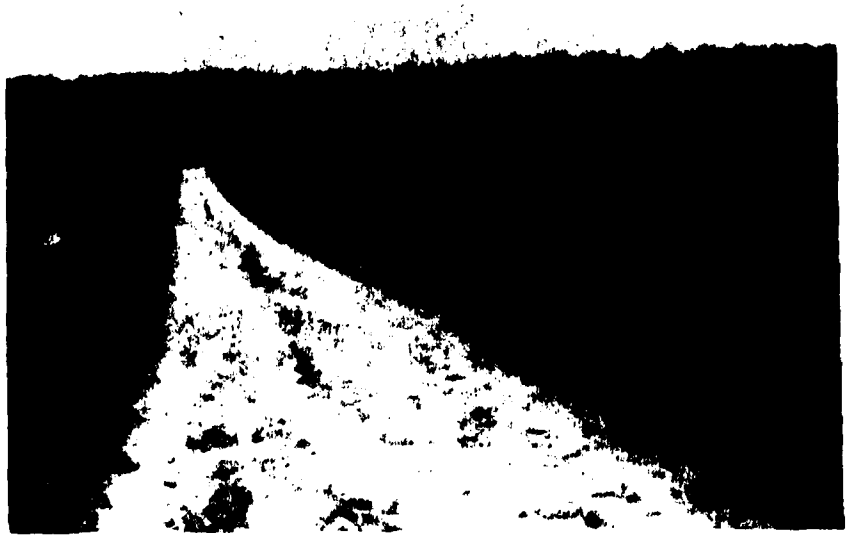


Figure 4 - Looking along the top of the dam embankment from the south abutment.

Figure 5 - Looking toward south abutment at vehicle tracks near downstream toe of dam.

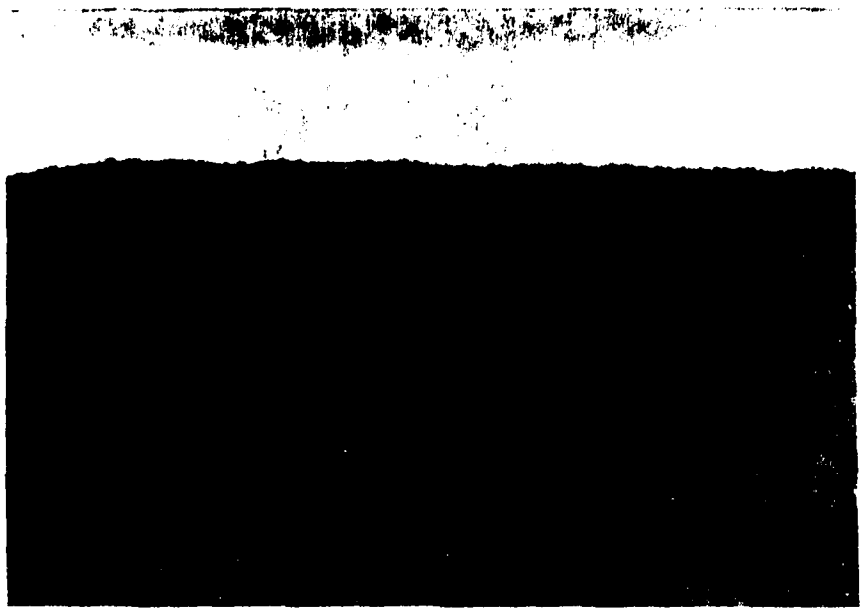


Figure 6 - Looking toward north abutment at vehicle tracks near downstream toe of dam.

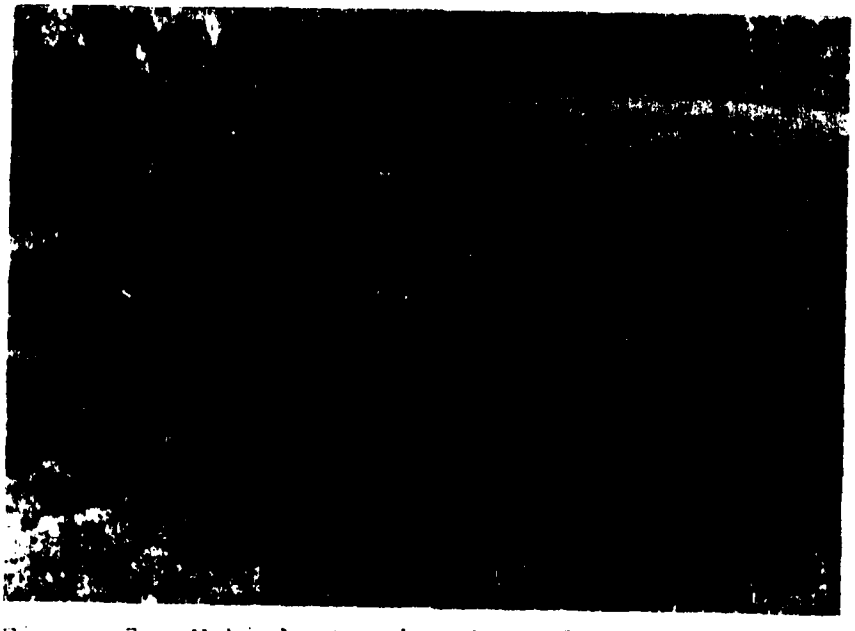


Figure 7 - Vehicle tracks along downstream toe near principal spillway discharge channel.

Figure 8 - Looking north at principal spillway outlet pipe and toe drains.

Figure 9 - Closeup of principal spillway outlet pipe and toe drains.

Figure 10 - Looking at a spring 100 feet downstream of the toe of dam near the south abutment.

Figure 11 - Looking southeast across emergency spillway and at north end of dam embankment.

Figure 12 - Looking at north end of dam embankment.

Figure 13 - Looking downstream from north bank of Jericho Lake at emergency spillway discharge channel.

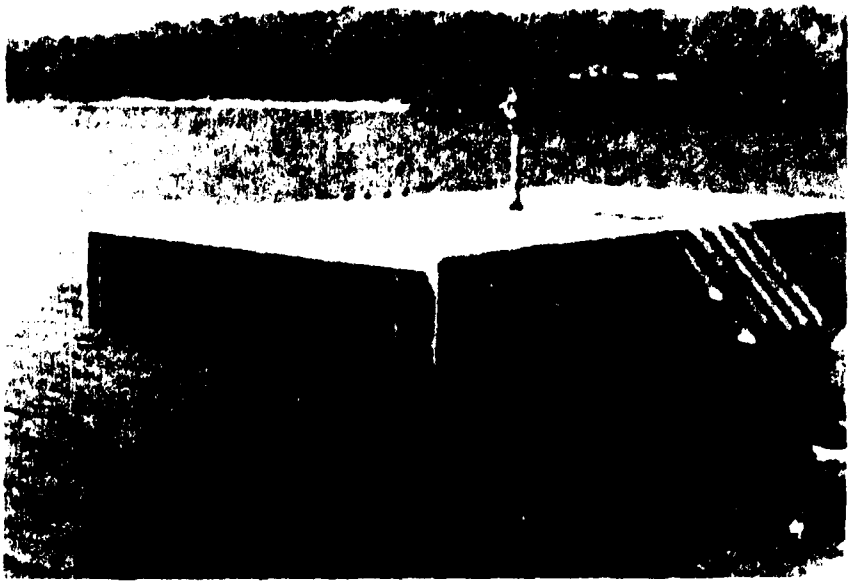


Figure 14 - Looking north at principal spillway riser.

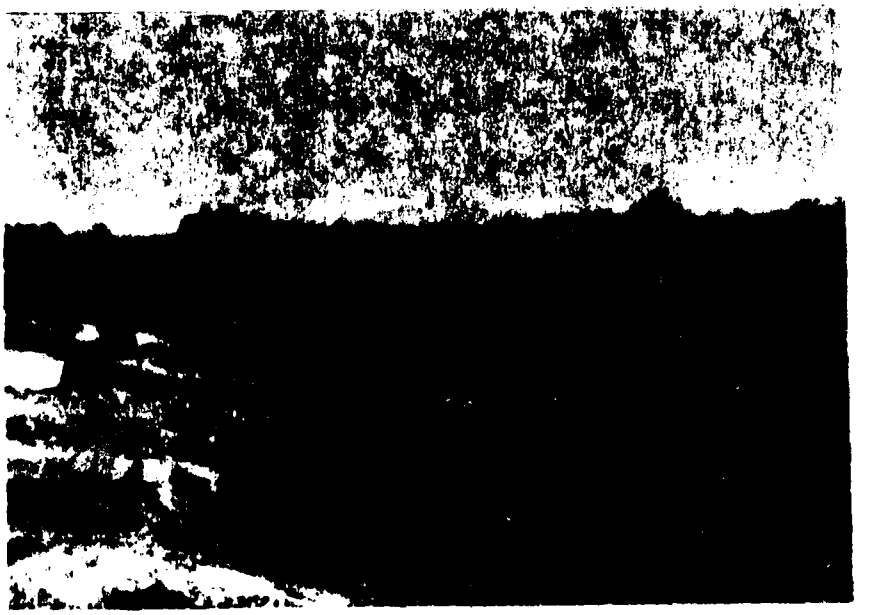


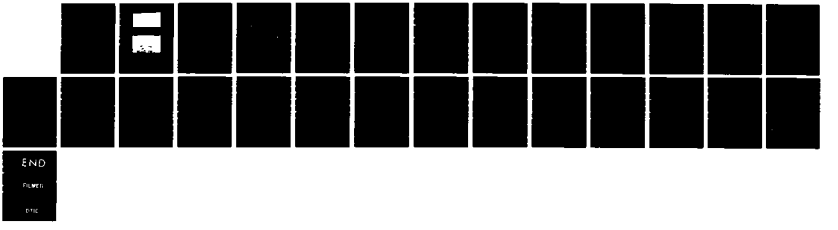
Figure 15 - Looking east at emergency spillway discharge channel.

Figure 16 - Looking south along crest of dike.

Figure 17 - Looking north along crest of dike from south abutment.

AD-A156 748 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 3/3
SITE NUMBER 1 DEAD RI.. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUL 79

UNCLASSIFIED F/G 13/13 NL



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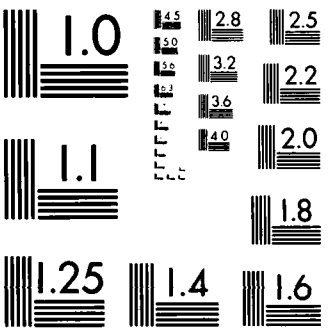


MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963 A

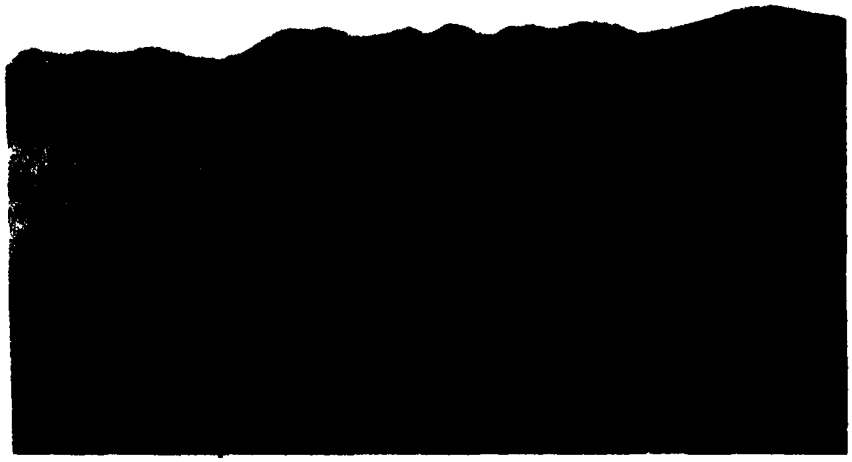
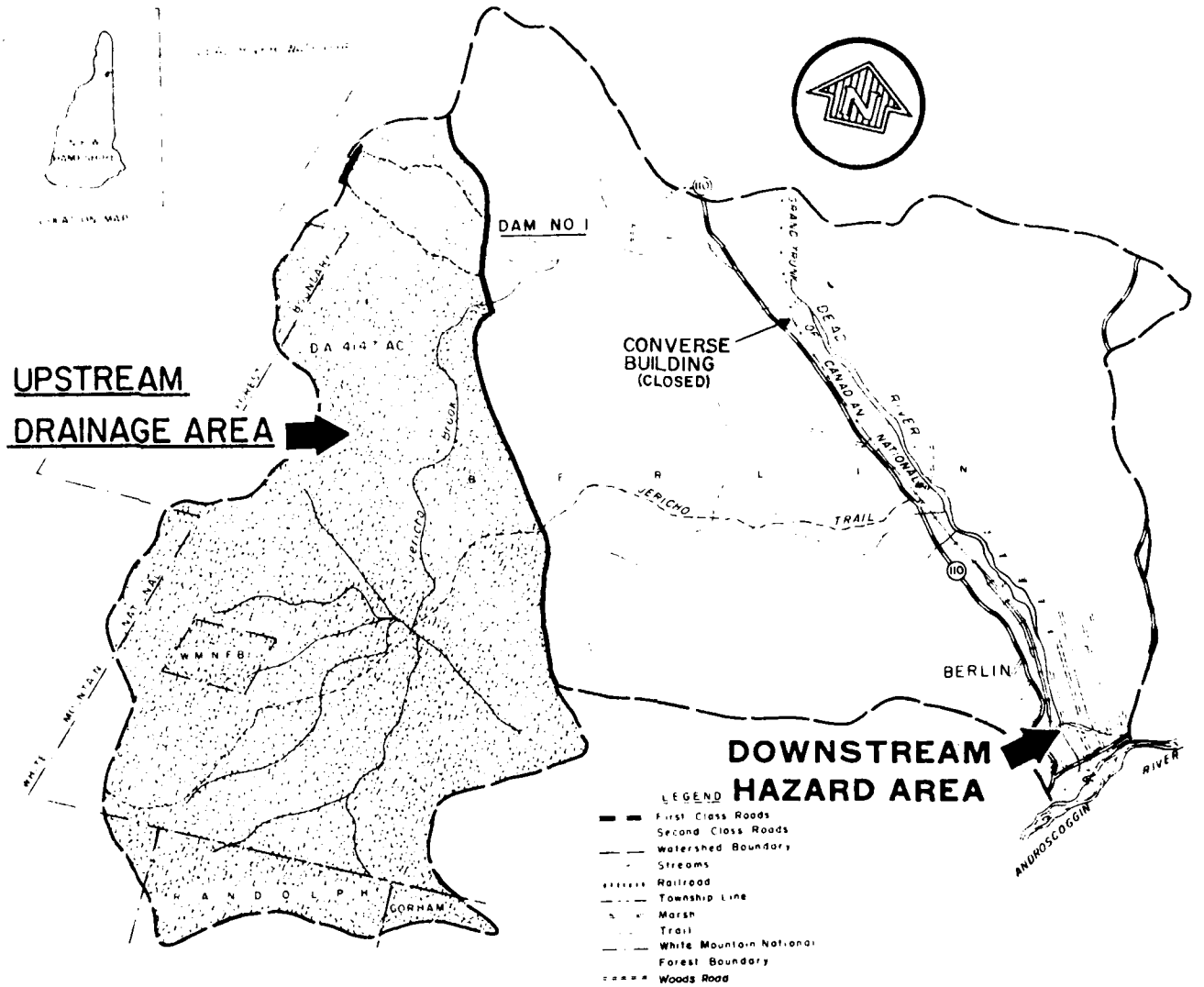


Figure 18 - Looking upstream from the crest of the dam embankment at Jericho Lake.

Figure 19 - Looking downstream at the principal spillway discharge channel.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SITE NO I DEAD RIVER DAM
BERLIN, NEW HAMPSHIRE

REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC. CONCORD, NH

SCALE IN MILES

0 1 2

MAP BASED ON, DEAD RIVER WATERSHED PROJECT COVER SHEET MAP. U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE.

Anderson-Nichols & Company, Inc.

Subject DEAD RIVER

Sheet No. 1 of 1
Date 4/18/79
Computed RHIVES
Checked

JOB NO.

SQUARES 1/4 IN. SCALE

DEAD RIVER SITE #1 (JERICHO BROOK)

TEST FLOOD ANALYSIS

DRAINAGE AREA: 6.48 mi²

STORAGE: @ NORMAL POOL (1352 msl) = 1239.6 ACRE-FEET
@ EMERGENCY SPWY CREST (1362 msl) = 2795.0 ACRE-FEET

SIZE CLASSIFICATION: INTERMEDIATE

HAZARD CLASSIFICATION: SIGNIFICANT

TEST FLOOD: PMF

DETERMINATION OF PROBABLE MAXIMUM FLOOD (PMF)

(1) USE COE/NED PMF PEAK FLOW RATES GRAPH - W/ BASIN (SLOPE IS 685 FT/MI) IN MOUNTAINOUS CATEGORY; FLOW RATE IS 2130 CSM

∴ PMF = 2130 CFS/SQ. MILE × 6.48 SQ. MILES = 13802 CFS

(2) FROM SOIL CONSERVATION SERVICE DESIGN DATA, A FREEBOARD HYDROGRAPH HAS BEEN DEVELOPED FOR A 6-HOUR STORM WITH 20.3 IN RAINFALL WHICH GENERATES 15.6 IN RUNOFF. RESULTING PEAK INFLOW IS 16870 CFS

DUE TO GREATER DETAIL OF SCS STUDY, THE TEST FLOOD WILL BE 16870 CFS. THIS WILL BE CONSIDERED THE PMF AS THE PROJECT DESIGN FLOOD > RECOMMENDED SPILLWAY DESIGN FLOOD (PMF)

ROUTING OF AN INFLOW VALUE OF 16870 BY SCS RESULTED IN AN OUTFLOW DISCHARGE OF 7975 CFS. THIS CORRESPONDS TO AN ELEVATION OF 1370.9' MSL ON THE RATING CURVE DEVELOPED FOR THE PRINCIPAL AND EMERGENCY SPILLWAYS (SEE APPENDIX B). THE CREST THE DAM IS 1371.0' (MSL).

SUMMARY: THE TEST FLOOD IS THE MAXIMUM CAPACITY OF THE PRINCIPAL AND EMERGENCY SPILLWAYS COMBINED JUST BEFORE THE DAM EMBANKMENT IS OVERTOPPED.

NOTE: SEE PLATE TITLED, "FLOOD ROUTING - EMERGENCY SPILLWAY HYDROGRAPH", APPENDIX "B" FOR DAM RATING CURVE.

DEAD RIVER SITE #1 (JERICHO BROOK)

BREACH ANALYSIS

I. GENERAL DISCUSSION OF ANALYSIS

(A.) DETERMINE DOWNSTREAM HAZARD CLASSIFICATION, FAILURE OF THE DAM WILL BECONSIDERED WITH THE WATER SUFACE ELEVATION OF UPSTREAM IMPOUNDMENT AT TWO DIFFERENT ELEVATIONS:

(1) WATER SURFACE AT NORMAL POOL (RECREATION POOL) ELEVATION OF 1352' msl.

(2) WATER SURFACE AT MAXIMUM POOL ELEVATION OR THE ELEVATION BEFORE FLOW OCCURS IN THE EMERGENCY SPILLWAY; CORRESPONDS TO CREST ELEVATION OF EMERGENCY SPILLWAY AT 1362' msl. (NOTE: DUE TO THE EXTREMELY LARGE CAPACITY OF THE EMERGENCY SPILLWAY, IT IS UNREALISTIC TO ASSUME MAXIMUM POOL ELEVATION AT TOP OF DAM EMBANKMENT — ELEVATION 1371' msl.)

?

IN BREACH ANALYSIS IT IS UNREALISTIC TO ASSUME THE BREACH WIDTH WOULD BE (.4)(DAM WITH) = (.4)(3035) = 1214'. THEREFORE, ASSUME BREACH WIDTH OF 100'.

(B.) METHODOLOGY EMPLOYED FOR THE CALCULATION OF BREACH DISCHARGES, USING FORMULA*:

$$Q_1 = 8/27\, W_b \sqrt{g}\, Y_o^{3/2}$$

WHERE:

Q_1 = BREACH DISCHARGE, CUBIC FEET PER SECOND

W_b = BREACH WIDTH, FEET

g = ACCELERATION DUE TO GRAVITY, 32.2 ft/sec^2

Y_o = DIFFERENCE OF POOL ELEVATION FROM UPSTREAM INVERT, FEET

NOTE: UPSTREAM INVERT = 1329.3' ms/

* BREACH DISCHARGE FORMULA FROM "RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS, COE, APRIL 1978.

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

(C.) DESCRIPTION OF DOWNSTREAM REACHES FROM SITE NO. 1, DEAD RIVER DAM

BASED UPON PHYSICAL CHARACTERISTICS THE WATERCOURSE HAS TWO DISTINCTLY DIFFERENT REACHES BELOW THE DAM.

(1) REACH 1 IS FROM THE DAM TO A POINT APPROXIMATELY 0.25 DOWNSTREAM OF THE JERICHO BROOK BY ROUTE 110, OR A TOTAL DISTANCE OF APPROXIMATELY 1.75 MILES DOWNSTREAM (EAST) OF THE DAM. THIS REACH HAS A STEEP SLOPE, HEAVILY WOODED OVERBANKS, AND A ROCKY CHANNEL BOTTOM. THERE ARE NO INHABITED STRUCTURES LOCATED IN THIS REACH WHICH WOULD BE AFFECTED BY THE BREACH OF THE DAM (AT NORMAL POOL ELEVATION)

(2) REACH 2 IS FROM THE POINT (1.75 MI. D/S DAM) WHERE JERICHO BROOK TURNS SHARPLY TO THE SOUTHEAST AND BECOMES KNOWN AS DEAD RIVER (FIELD INSPECTION HAS REVEALED THAT JERICHO BROOK AND DEAD RIVER ARE THE SAME WATERCOURSE) TO THE JUNCTION OF THE DEAD RIVER WITH THE ANDROSCOGGIN RIVER 3.0± MILES DOWNSTREAM. IN THIS REACH THE DEAD RIVER HAS A WIDE FLAT FLOODPLAIN WITH CONSIDERABLE STORAGE AND HAS AN EXTREMELY FLAT CHANNEL GRADIENT. ON THE SOUTH BOUNDARY OF THE FLOODPLAIN IS THE GRAND TRUNK CANADIAN NATIONAL RAILROAD, ROUTE 110 AND NUMEROUS COMMERCIAL, INDUSTRIAL, AND RESIDENTIAL BUILDINGS. IN ADDITION, FOR THE LAST 0.75 MILES OF ITS COURSE, THE DEAD RIVER FLOWS THROUGH A HEAVILY URBANIZED AREA OF THE CITY OF BERLIN INCLUDING THE CENTRAL BUSINESS DISTRICT.

II. SUMMARY OF BREACH WITH RESERVOIR AT NORMAL OR RECREATION POOL LEVEL (1352.0 FT. MSL)

(A.) BREACH DISCHARGE, Q_1 DETERMINATION

$Q_1 = 8/27\ W_b \sqrt{g}\ Y_o^{3/2}$

W_b = 100 FEET

$\sqrt{g}$ = 5.67 FEET$^{1/2}$/SECOND

Y_o = (1352.0 - 1329.3) FEET = 22.7 FEET

$Q_1 = 8/27 \cdot 100 \cdot 5.67\ (22.7)^{3/2} = 18169$ CFS

ASSUME MINIMAL ANTECENDENT DISCHARGE, Q_2

Q_2 = DISCHARGE OVER PRINCIPAL SPILLWAY (TWO-STAGE RISER) = 25 CFS (STAGE IS 2 FEET)

TOTAL BREACH DISCHARGE IS 18169 + 25 = 18194 ≅ 18200 cfs

(B) DISCUSSION OF RESULT OF (A.) BREACH AT NORMAL POOL UPON DOWNSTREAM REACHES, INCLUDES HISTORICAL FLOODING

(1) REACH 1 — NO IMPACT ON INHABITED STRUCTURES; THE RT. 110 CROSSING OF JERICHO BROOK COULD BE COMPLETELY INUNDATED WITH A DEPTH OF FLOODING OF APPROXIMATELY 7.0 FEET (SEE CALCULATIONS ON PAGES 10-15 OF 18)

(2) REACH 2 -

(a) THE FIRST STRUCTURE AFFECTED BY THE DAM'S BREACH IS LIKELY TO BE THE CONVERSE BUILDING (CLOSED) ON THE NORTH SIDE OF ROUTE 110 (BETWEEN ROUTE 110 AND THE RR TRACKS) 0.4 MILES BELOW OR SOUTHEAST OF ROUTE 110's CROSSING OF JERICHO BROOK. ASSUMING:

(1) NO REACH STORAGE ABOVE CONVERSE BUILDING DUE TO STEEP SLOPE OF STREAM

(2) MINIMAL ANTECEDENT FLOW, 25 CFS

THE BREACH DISCHARGE CORRESPONDS TO A DEPTH OF FLOODING OF APPROXIMATELY 13.2 FEET ON THE STAGE-DISCHARGE RATING CURVE DEVELOPED FOR REPRESENTATIVE CROSS-SECTION AT CONVERSE BUILDING (SEE PAGES 6-9 OF 18 FOR CALCULATIONS). ONCE FLOW OVERTOPS THE RAILROAD TRACK EMBANKMENT, THE CONVERSE BUILDING COULD BE FLOODED; THE EMBANKMENT

IS APPROXIMATELY 100' ABOVE THE CHANNEL INVERT AND THE CONVERSE BUILDING SILL IS 2 FEET BELOW THE TOP OF THE EMBANKMENT. THEREFORE, A 3-5-FOOT DEPTH OF FLOODING COULD BE EXPECTED AT THE CONVERSE BUILDING WITH THE DAM BEING BREACHED (AT NORMAL POOL ELEVATION), CAUSING CONSIDERABLE DAMAGE.

(b) FLOODING HISTORY — DOWNSTREAM IN REACH 2 IS THE URBANIZED AREA OF BERLIN ALONG THE DEAD RIVER WATERCOURSE, WHICH IS THE GREATER DOWNSTREAM HAZARD AREA. THIS AREA HAS EXPERIENCED EXCESSIVE FLOOD DAMAGES ON AT LEAST THREE OCCASIONS IN THIS CENTURY. MAJOR FLOODING EVENTS IN THIS AREA IN 1927, 1936, AND 1953 WERE RESPONSIBLE FOR THE CONSTRUCTION OF THE MULTIPLE-PURPOSE (FLOOD CONTROL AND RECREATION) STRUCTURES, INCLUDING THE DAM AND THE DIKE, AT SITE NO. 1, DEAD RIVER WATERSHED. THE CONSIDERABLE FLOODING PROBLEMS EXPERIENCED ON THE DEAD RIVER IN THE CITY OF BERLIN ARE DISCUSSED EXTENSIVELY IN THE <u>WORK PLAN FOR WATERSHED PROTECTION, FLOOD PREVENTION, AND RECREATION, DEAD RIVER WATERSHED</u> (JUNE 1965, USDA SOIL CONSERVATION SERVICE, COOS COUNTY SOIL CONSERVATION DISTRICT.

SEVERAL EXCERPTS FROM THIS PUBLICATION INCLUDE:

"PAST RECORDS SHOW THAT FLOODING FROM THE DEAD RIVER HAS CONSTANTLY PLAGUED THE CITIZENRY OF BERLIN. ON A NUMBER OF OCCASIONS, FLOODS HAVE DISRUPTED TRANSPORTATION AND CAUSED SERIOUS DAMAGE TO RESIDENCES AND BUSINESS AND COMMERCIAL ESTABLISHMENTS. LOCAL CITIZENS IN BERLIN FEEL FORTUNATE THERE HAS NEVER BEEN LOSS OF LIFE IN THE TREACHEROUS DEAD RIVER CHANNEL DURING PERIODS OF FLOODING." PAGE 12

"THE PRINCIPAL FLOODWATER DAMAGES ARE TO

INDUSTRIAL, COMMERCIAL, AND RESIDENTIAL PROPERTY AND ROADS AND BRIDGES IN BERLIN. IN THE FLOODPLAIN BETWEEN HILLSIDE AVE. AND MAIN ST. THERE ARE APPROXIMATELY 26 RESIDENTIAL AND 44 COMMERCIAL BUILDINGS SUBJECT TO FLOOD DAMAGE FROM LARGE FLOODS." PAGE 7

(c) SUMMARY OF BREACH ANALYSIS ON REACH 2— THE 1936 AND 1953 FLOODS WITH DISCHARGES ESTIMATED TO HAVE BEEN 2000 CFS AND 1000 CFS AND RECURRENCE INTERVALS OF 100 AND 33 YEARS, RESPECTIVELY, CAUSED CONSIDERABLE DAMAGE TO BERLIN. BREACH OF THE DAM, WITH JERICHO LAKE AT NORMAL OR RECREATION POOL, COULD RESULT IN A DISCHARGE OF 18200 CFS, WHICH WOULD OVERTOP THE MAIN ST BRIDGE BY APPROXIMATELY 4 FEET. (SEE CALCULATIONS ON PAGES 15-18 OF 18) CAUSING AN EXCESSIVE AMOUNT OF DAMAGE TO MAIN ST. STORES AND POSSIBLY CONSIDERABLE LOSS OF LIFE (10 OR MORE).
THE DAM IS THEREFORE CONSIDERED TO BE OF HIGH HAZARD POTENTIAL DUE TO THIS LIKLIHOOD OF SEVERE FLOODING IN THE CITY OF BERLIN.

(IV) BREACH OF DAM WITH RESERVOIR AT CREST OF EMERGENCY SPILLWAY (1362.0 FT. MSL)

THOUGH ANALYSIS NOT REQUIRED TO DETERMINE HAZARD BASED ON NORMAL POOL BRECH COMPUTATIONS, A BREACH OF DAM AT EMERGENCY SPILLWAY CREST WOULD RESULT IN DISCHARGE OF 31415 CFS AND

$$Q_1 = 8/27 \cdot 100 (5.67)(1362-1329.3)^{3/2}$$
$$= 31415 \text{ CFS}$$

CONSIDERABLY GREATER DAMAGES IN THE CITY OF BERLIN.

NOTE: RECONSTRUCTION OF MAIN ST. BRIDGE TO PASS 100-YEAR EVENT (1200 CFS) WOULD NOT ELIMINATE SEVERE FLOODING WITH DISCHARGE OF 18200 CFS.

Q_2 = DISCHARGE OVER PRINCIPAL SPILLWAY (TWO STAGE RISER) = 280 CFS (FROM SPILLWAY RATING CURVE)

$Q_{TOTAL} = Q_1 + Q_2 = 31,415 + 250 = 31,665$
say 31,700 CFS

② REACH 2:
FROM SHT 9 OF 18 – FLOOD DEPTH = 17.0' ABOVE CHANNEL INVERT AT CONVERSE BLDG
∴ 7' OF FLOODING WOULD BE EXPECTED AT THE BLDG ITSELF

@ MAIN ST – 3-4 FT OF FLOODING COULD BE EXPECTED (SEE SHT 16A, 18 OF 18)

① REACH 1: 8.5 – 9.0' FLOOD DEPTH OVER BRIDGE (SEE SHT 12 AND 13 OF 18)

NOTE: SEE PLATE TITLED, "FLOOD ROUTING – EMERGENCY SPILLWAY HYDROGRAPH", APPENDIX "B" FOR DAM RATING CURVE.

Anderson-Nichols & Company, Inc.

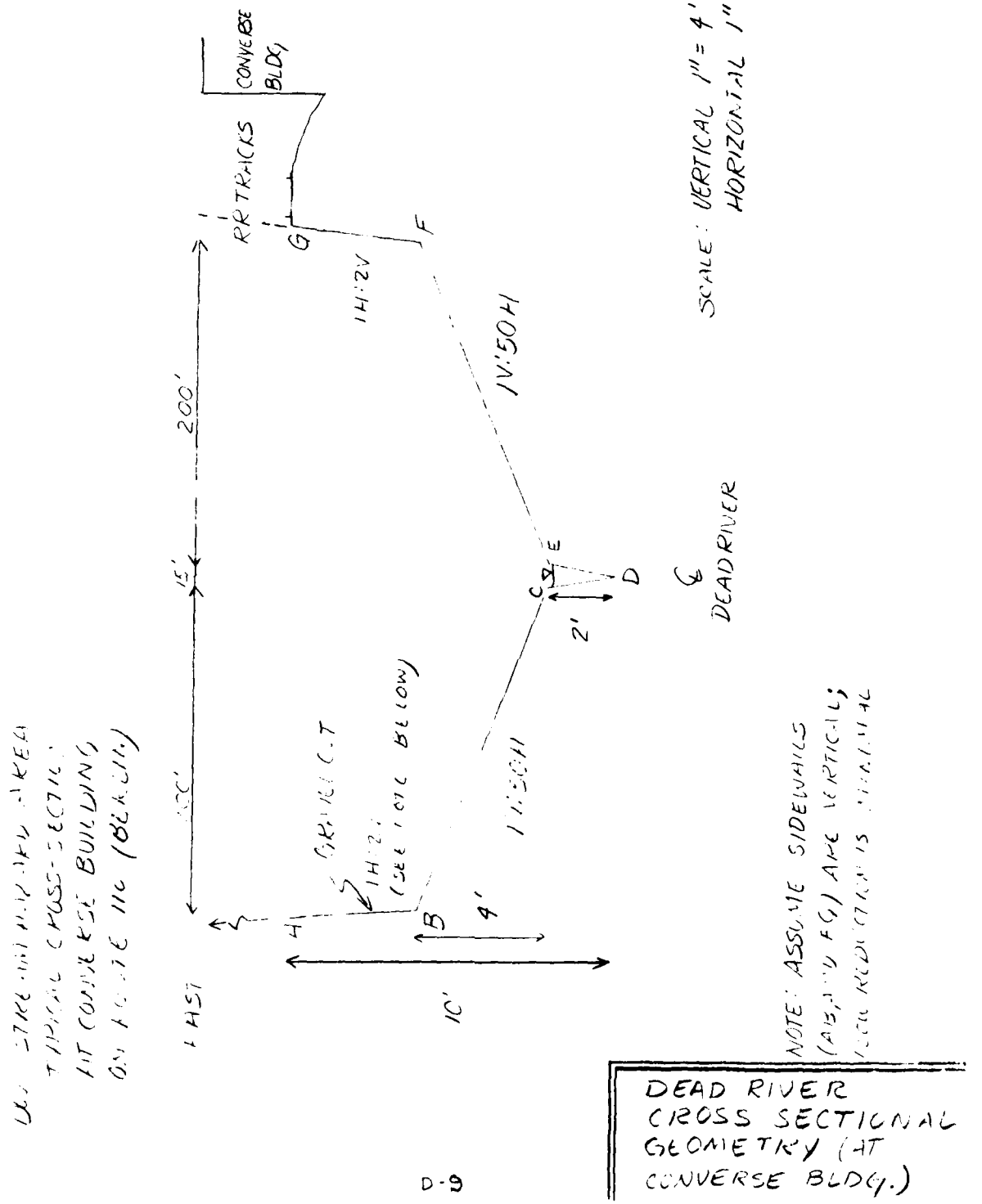
JOB NO. 3273-11

Subject DEAD RIVER DAM BREACH

Sheet No. 6 of 18
Date 6/19/79
Computed RH IVES
Checked

SQUARES 1/4 IN. SCALE

(V) BREACH CALCULATIONS FOR:
A. IMPACT AT CONVERSE BLDG. ON RT. 110



DEAD RIVER CROSS SECTIONAL GEOMETRY (AT CONVERSE BLDG.)

USING CROSS SECTIONAL GEOMETRY AND CHANNEL SLOPE IN MANNING'S EQUATION, STAGE-DISCHARGE RATING CURVE CAN BE DEVELOPED FOR THE CROSS SECTION

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

WHERE: Q = DISCHARGE, (CFS)
A = CROSS-SECTIONAL AREA, ($FT.^2$)
R = HYDRAULIC RADIUS, (FT.)
S = SLOPE, (FT/FT)
η = FRICTION FACTOR

S (SLOPE) IS ESTIMATED TO BE 0.002 FROM USGS QUAD SHEET
η (FRICTION FACTOR) IS 0.04; ALSO OVERBANKS ARE ESSENTIALLY GRAVEL W/ LITTLE VEGETATION, THEREFORE, USE 0.04 FOR COMPOSITE η VALUE FOR CHANNEL AND OVERBANKS

STAGE (FT.)	AREA (FT^2) CHAN.	LOB	ROB	TOTAL AREA (FT^2)	WP (FT.)	R (FT.)	S (FT./FT.)	η	Q* (CFS)
2	15	0	0	15	15	1.0	0.002	0.04	25
4	45	100	100	245	215	1.14			444
6	75	400	400	875	815	1.07			1520
8	105	800	800	1705	815	2.09			4631
10	135	1200	1200	2535	815	3.11			8977
12	165	1600	1600	3365	815	4.12			14367
14	195	2000	2000	4195	815	5.12			20705
16	225	2400	2400	5025	815	6.12			27934

* SEE DISCHARGE CALCULATIONS ON PAGE 8 OF 15

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
NH	473	NED	NH	019	02				SITE NO. 1, DEAD RIVER	4429.8	7151.8	12JUL79

POPULAR NAME	NAME OF IMPOUNDMENT
JERICHO LAKE DAM	JERICHO LAKE

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	JERICHO BROOK	BERLIN	4	15256

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC. (FT.)	HYDRAU. (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPG	1970	CR	47	47	4720	1240	NED	N	N	N	B	

REMARKS
20-1970

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY W'D'TH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	2935	U	126	8202	333705											

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF BERLIN	SOIL CONSERVATION SERVIC	ROGERS CONSTRUCTION COMP

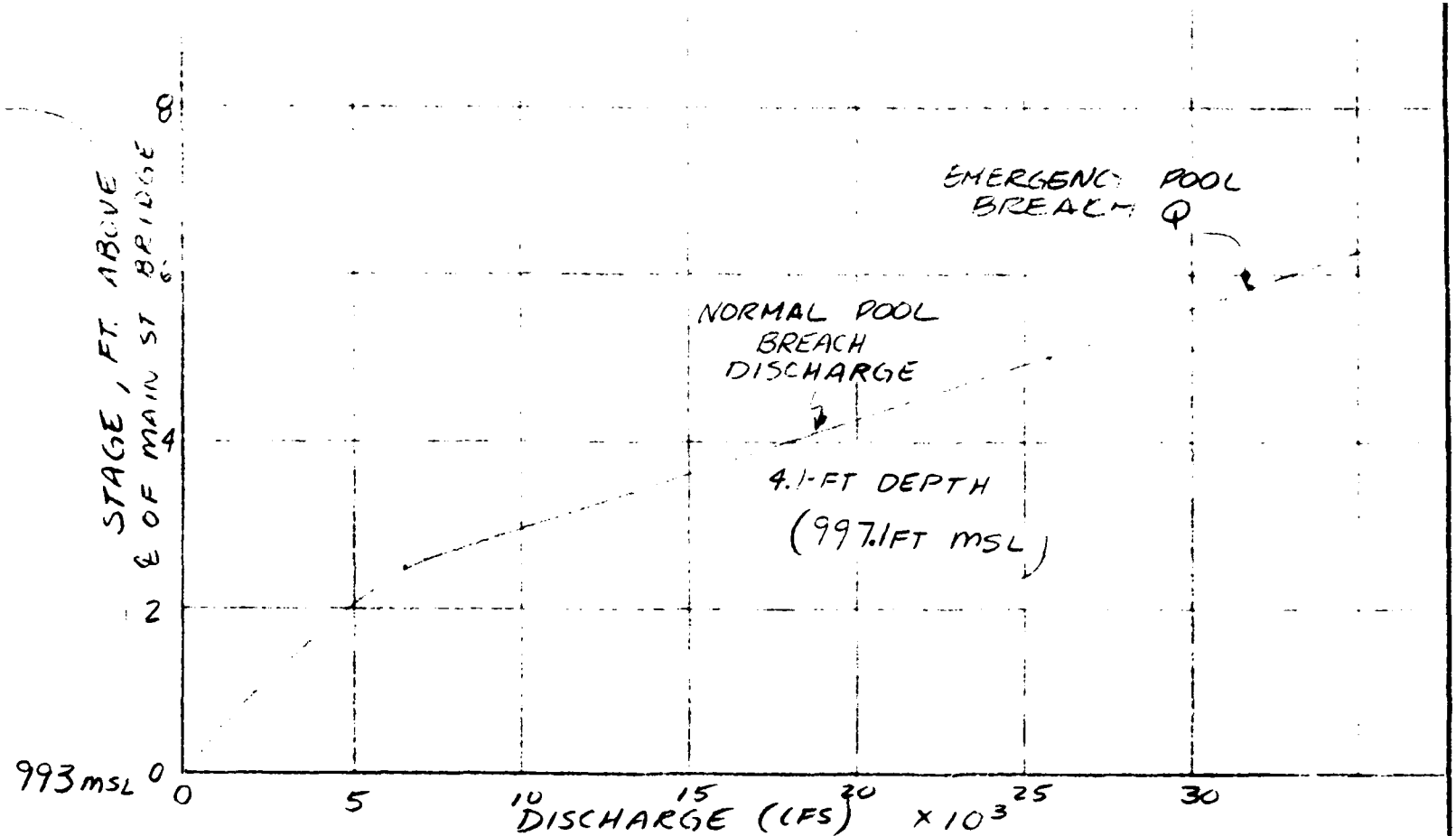
REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
SCS	SCS	SCS	SCS

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
ANDERSON-NICHOLS AND COMPANY, INC	07JUN 9	PL92-367

REMARKS
32-TWO-STAGE RISER TOTALING 26 FEET, EMERGENCY SPILLWAY 100 FEET WIDE

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS



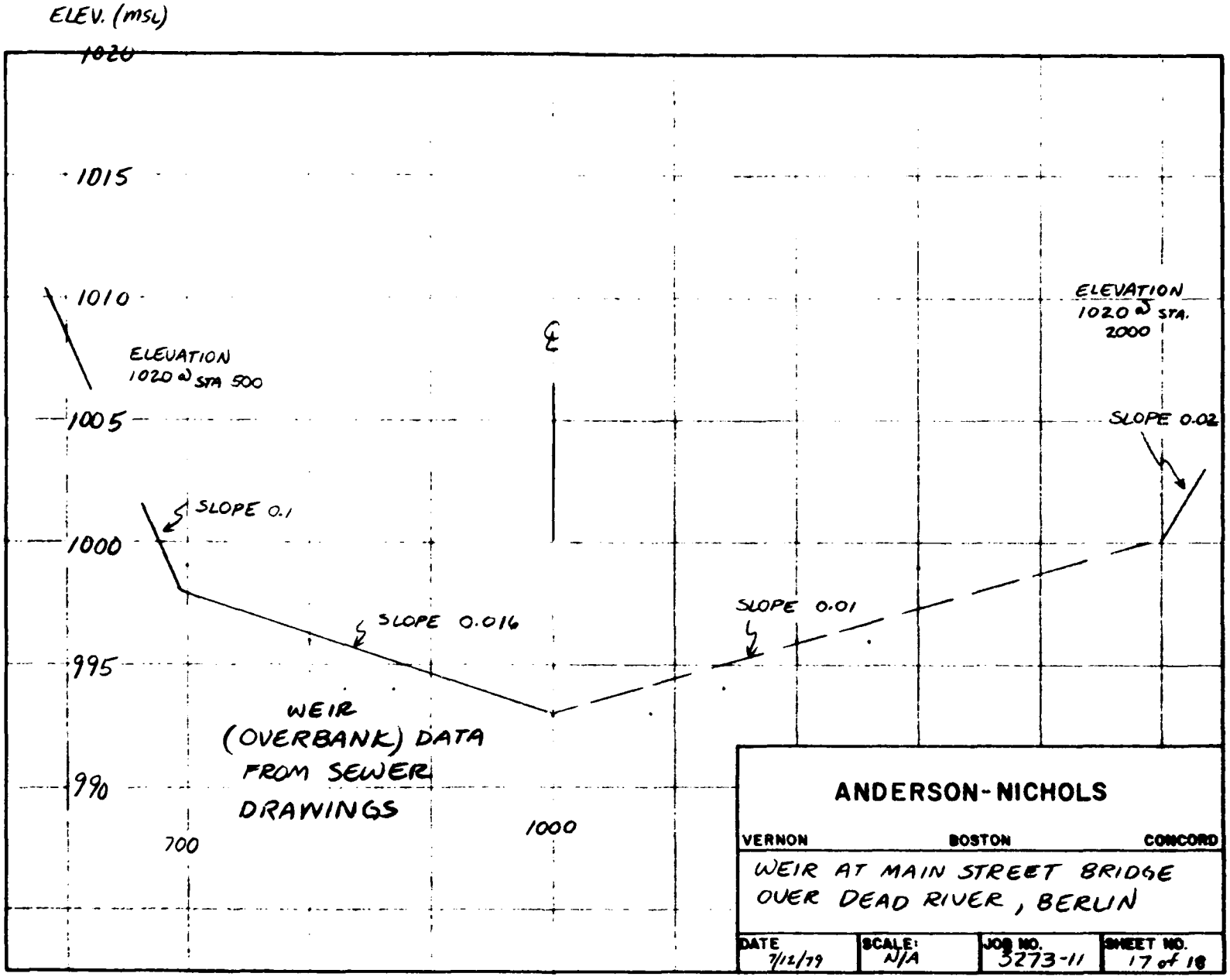
D-22

ANDERSON-NICHOLS

VERNON BOSTON CONCORD

RATING CURVE, MAIN ST. BRIDGE
BERLIN, DEAD RIVER

DATE	SCALE:	JOB NO. 3273-11	SHEET NO. 18 of 18



D-21

ANDERSON-NICHOLS

VERNON BOSTON CONCORD

WEIR AT MAIN STREET BRIDGE OVER DEAD RIVER, BERLIN

DATE	SCALE:	JOB NO.	SHEET NO.
7/12/79	N/A	3273-11	17 of 18

Anderson-Nichols & Company, Inc.

Subject

Sheet No. 16A of 18

Date

Computed

Checked

JOB NO.

SQUARES 1/4 IN. SCALE

FOR THE CASE OF BREACH AT EMERGENCY SPILLWAY ELEVATION A RESULTING FLOOD DEPTH BETWEN 3 to 4 FEET WOULD BE EXPECTED AT MAIN ST. (SEE SHT 18 OF 18)

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

(C)

DETERMINATION OF FLOOD DEPTHS AT MAIN ST BRIDGE, BERLIN

BRIDGE SPECIFICATIONS: CONC BOX, 10'H X 13'W, WEIR COEFF = 2.6

(1) Q: AT TOP OF ROAD, EL. 993 MSL (INVERT 976.0 MSL)

(a) ORIFICE FLOW

HEADWATER DEPTH IN TERMS OF DEPTH (HW/D) = $17/10 = 1.7$

FROM BPR CHART (p. 15) Q = 2210 CFS ($170\ CFS/FT \times 13\ FT$)

(2) Q: FLOOD DEPTH OF 5' OVER ROAD, EL. 998 MSL

(a) ORIFICE FLOW

HEADWATER DEPTH IN TERMS OF DEPTH (HW/D) = $22/10 = 2.2$

FROM BPR CHART Q = 2600 CFS ($200\ CFS/FT \times 13\ FT$)

(b) WEIR FLOW

$Q = CLH^{3/2} = 2.6\,(5/.017 + 5/.01)(5)^{3/2} = 23084$ CFS

TOTAL FLOW = ORIFICE AND WEIR FLOW = 2600 + 23084 CFS

= 25684 CFS

(3) Q: FLOOD DEPTH OF 2.5' OVER ROAD, EL. 995.5 msl

(a) ORIFICE FLOW

HEADWATER DEPTH IN TERMS OF DEPTH (HW/D) = $19.5/10 = 1.95$

FROM BPR CHART Q = 2470 CFS ($190\ CFS/FT \times 13\ FT$)

(b) WEIR FLOW

$Q = CLH^{3/2} = 2.6\,(2.5/.017 + 2.5/.01)(2.5)^{3/2} = 4081$ CFS

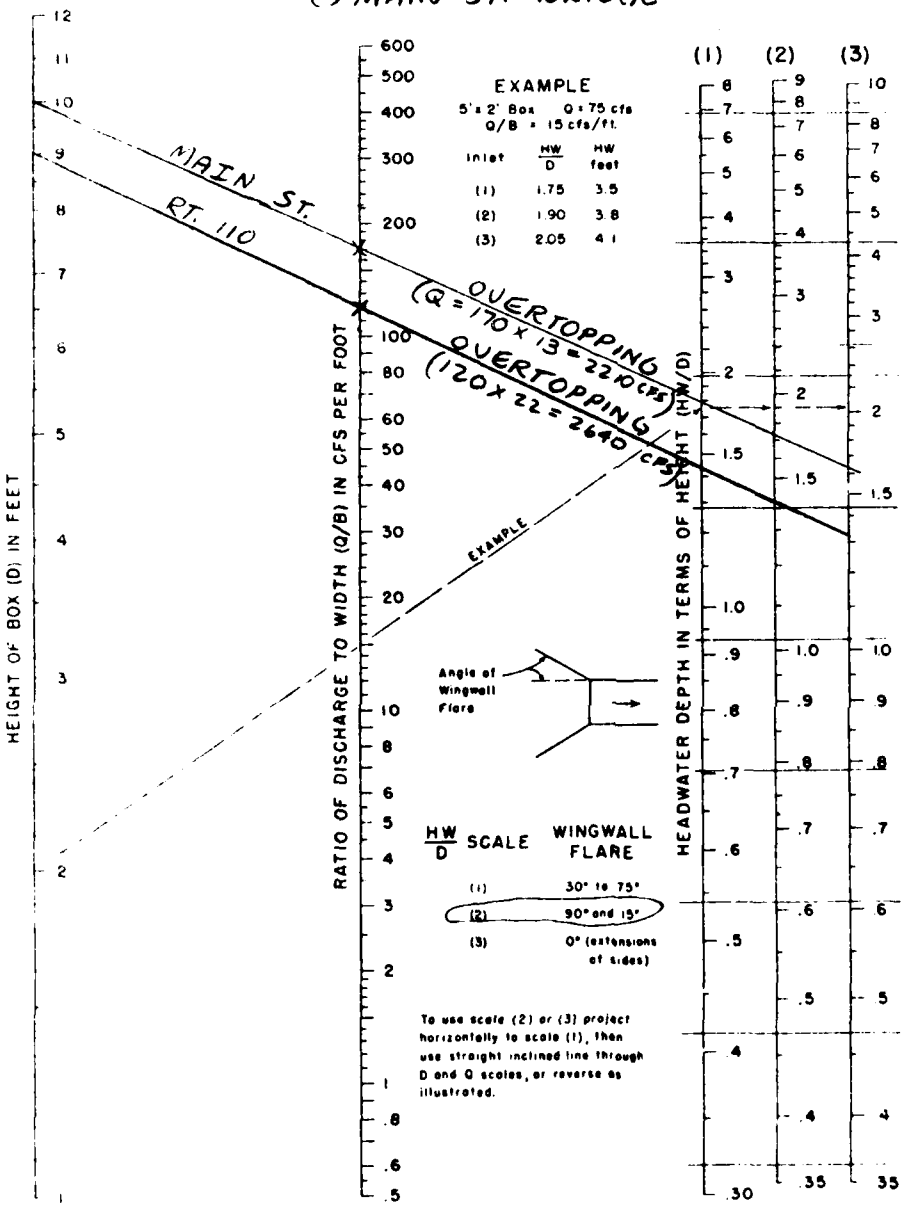
TOTAL FLOW = 2470 + 4081 = 6551 CFS

SUMMARY

FROM RATING CURVE, CONSTRUCTED FOR MAIN ST. BRIDGE, A FLOOD DEPTH OF APPROXIMATELY 4 FEET OVER THE ROAD (STAGE OF 21 FT, 997 msl) COULD RESULT IF THE DAM WERE BREACHED. THIS WOULD RESULT IN FIRST FLOOR FLOODING BY 2 to 3 FEET OF NUMEROUS STORES ON MAIN ST, AS IS INDICATED BY ELEVATIONS (1st FLOOR) SHOWN ON SEWER DRAWINGS, CAUSING EXCESSIVE DAMAGE.

CHART FOR DETERMINING ORIFICE FLOW FOR:
(1) ROUTE 110 BRIDGE
(2) MAIN ST. BRIDGE

CHART I

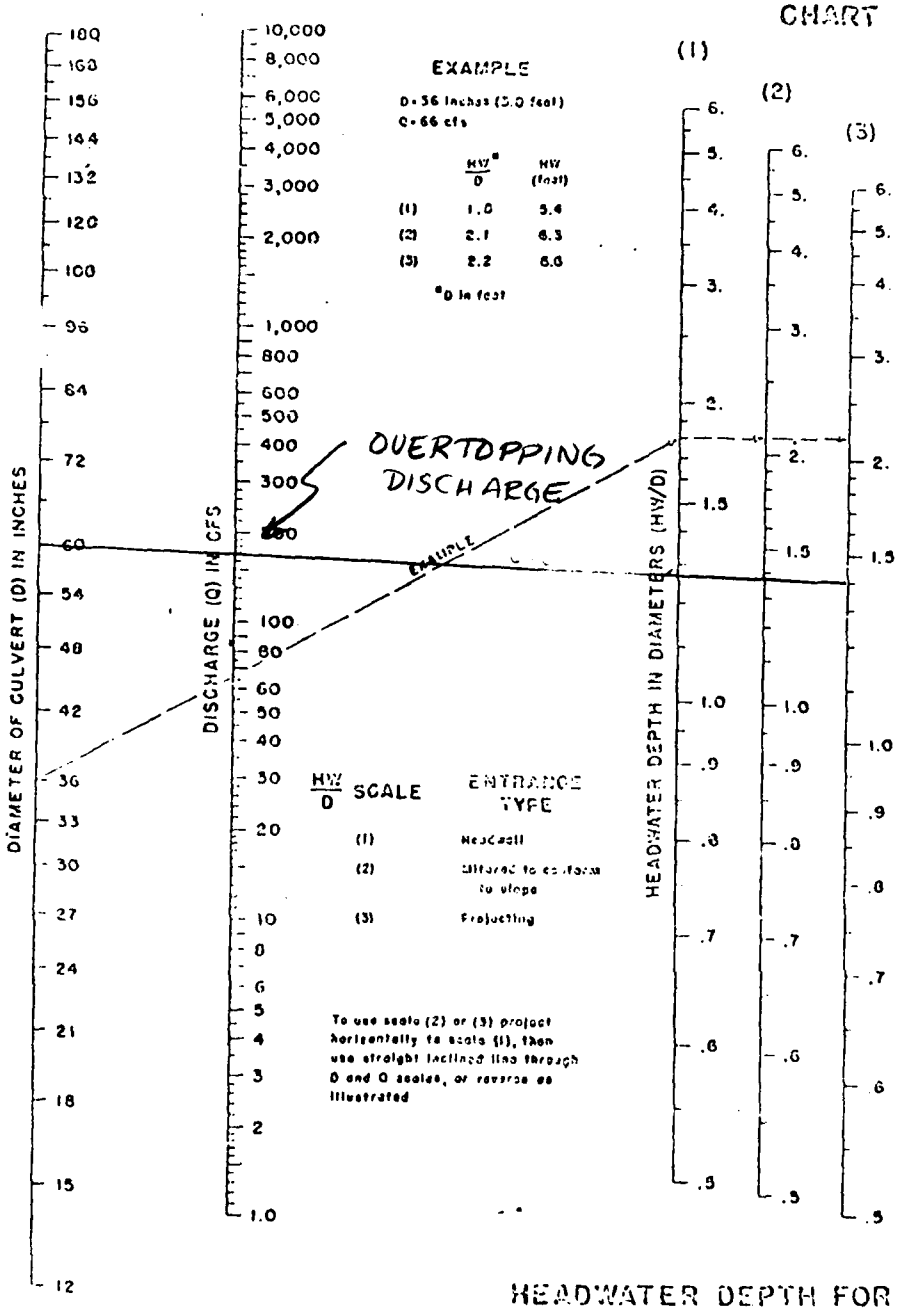


HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

HYDRAULIC CHART FOR BOX CULVERTS
Route 110
MAIN Street

5'- DIAMETER CMP ON DIRT RD. (UNNAMED) WITH PROJECTING ENTRANCE

CHART 4



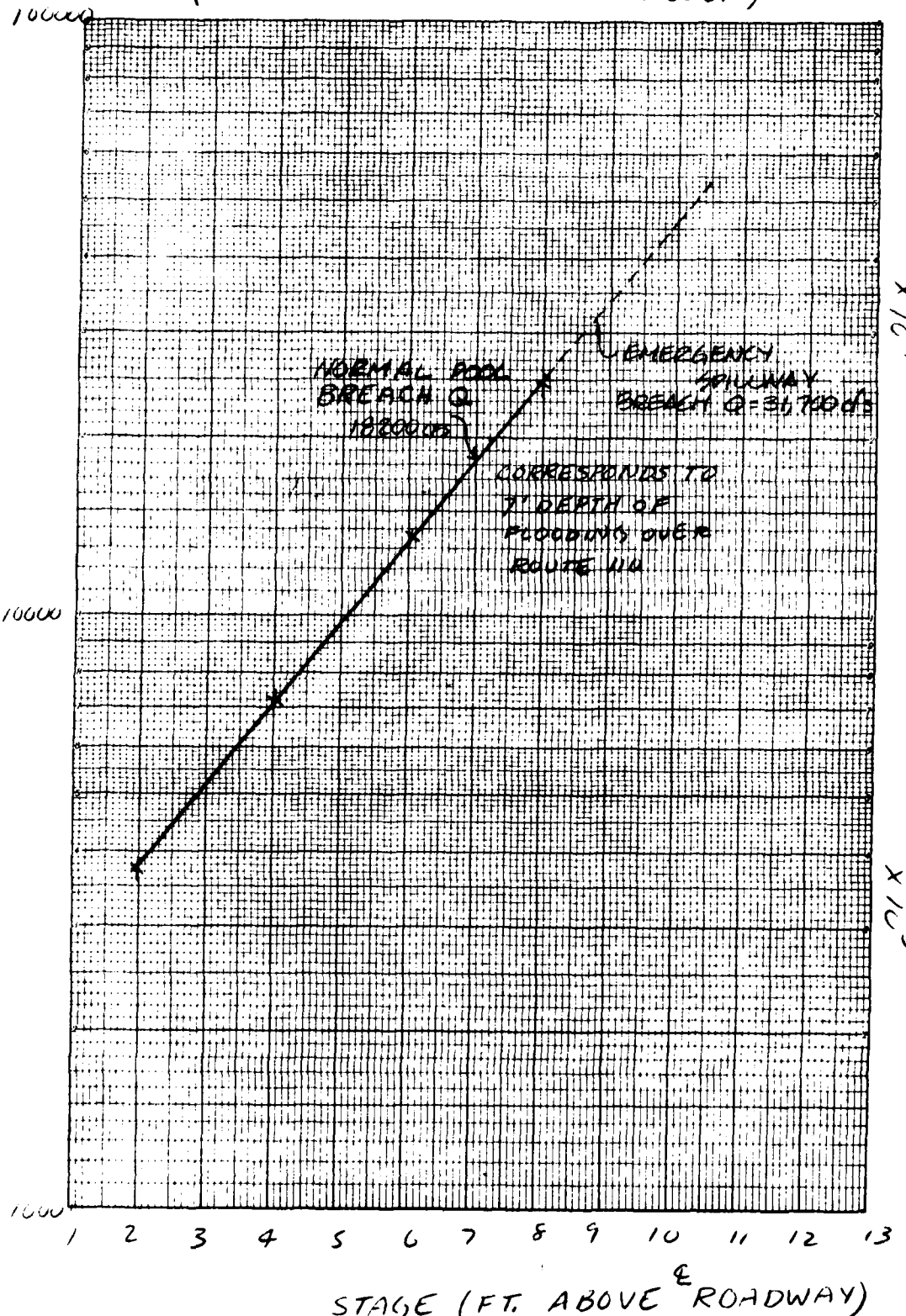
BUREAU OF PUBLIC ROADS

D-17

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

RT. 110 STAGE-DISCHARGE

(BRIDGE OVER JERICHO BROOK)



SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

STAGE-DISCHARGE RELATIONSHIP (SEE PAGE 13) INDICATES THAT THE BREACH DISCHARGE (18200 CFS) WOULD RESULT ROUGHLY A 7.0-FOOT DEPTH OF FLOODING OVER THE ROUTE 110 ROADWAY AT THE BRIDGE OVER JERICHO BROOK.

BREACH DISCHARGE (31,700 CFS) WOULD RESULT IN A 8.5 to 9.0 FOOT DEPTH OF FLOODING OVER RT 110 ROADWAY AT THE BRIDGE OVER JERICHO BROOK.

RT 110 CONT.

$Q = CLH^{3/2}$ WHERE:

Q = WEIR DISCHARGE (CFS)
L = WEIR SECTION LENGTH (FT)
H = AVERAGE DEPTH OF FLOODING, IS HALF THE FLOOD DEPTH AT BRIDGE ℄

TRIAL #1: FLOOD DEPTH @ ℄ = 2'

WEIR FLOW (LEFT ROADWAY) =
$2.6(2/.04)(1)^{3/2} = 130$ CFS

WEIR FLOW (RIGHT ROADWAY =
$2.6(2/.01)(1)^{3/2} = 520$ CFS

ORIFICE FLOW (HW/D = 9+6/9 = 1.7) IS 140 CFS/FT × 22 FT = 3080 CFS

TOTAL FLOW W/ 2' FLOOD DEPTH IS COMBINED PRESSURE AND WEIR FLOW = 3080 + 130 + 520 = 3730 CFS

TRIAL #2: FLOOD DEPTH @ ℄ = 4'

WEIR FLOW (LEFT) =
$2.6(4/.04)(2)^{3/2} = 735$ CFS

WEIR FLOW (RIGHT) =
$2.6(4/.01)(2)^{3/2} = 2942$ CFS

ORIFICE FLOW (HW/D = 9+8/9 = 1.9) IS 155 CFS/FT × 22 FT. = 3410 CFS

TOTAL FLOW IS 3410 + 735 + 2942 = 7087 CFS

TRIAL #3: FLOOD DEPTH @ ℄ = 6'

WEIR FLOW (LEFT) =
$2.6(6/.04)(3)^{3/2} = 2026$ CFS

WEIR FLOW (RIGHT)
$2.6(6/.01)(3)^{3/2} = 8106$ CFS

ORIFICE FLOW (HW/D = 9+10/9 = 2.1) IS 165 CFS/FT × 22 FT = 3630 CFS

TOTAL FLOW IS 3630 + 2026 + 8106 = 13762 CFS

TRIAL #4: FLOOD DEPTH @ ℄ = 8'

WEIR FLOW (LEFT) =
$2.6(8/.04)(4)^{3/2} = 4160$ CFS

WEIR FLOW (RIGHT) =
$2.6(8/.01)(4)^{3/2} = 16640$ CFS

ORIFICE FLOW (HW/D = 9+12/9 = 2.3) IS 180 CFS/FT × 22 FT = 3960

TOTAL FLOW IS 3960 + 4160 + 16640 = 24760 CFS

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

VI

ANALYSIS OF DOWNSTREAM BRIDGES AND CULVERTS

(A) 5-FOOT DIAMETER CORRUGATED METAL PIPE ON DIRT RD. .5mi DOWNSTREAM OF DAM.

TOP OF ROAD (CENTERLINE OF CULVERT) IS 2 FEET ABOVE LOW CHORD. THEREFORE, HEADWATER, IN TERMS OF DIAMETER (HW/D), IS 1.4 BEFORE STRUCTURE IS OVERTOPPED. CAPACITY OF CULVERT, BEFORE OVERTOPPING, IS 170 CFS (SEE PAGE 14 OF 18). BREACH DISCHARGE WOULD PROBABLY WASH OUT THE LOW EARTHEN EMBANKMENT

(B) 9'X22' CONCRETE BOX CULVERT ON ROUTE 110

TOP OF ROAD (CENTERLINE OF BRIDGE) IS APPROXIMATELY 4 FEET ABOVE LOW CHORD. THEREFORE, HEADWATER IN TERMS OF DEPTH BEFORE ROADWAY IS OVERTOPPED IS 1.4=(9+4)/9. CAPACITY OF STRUCTURE BEFORE ROADWAY IS OVERTOPPED IS ROUGHLY 2640 CFS (22' WIDE TIMES 120 CFS PER FOOT OF WIDTH), SEE PAGE 15.

TO DETERMINE IMPACT OF BREACH, MUST DEVELOP STAGE-DISCHARGE CURVE FOR STRUCTURE TO GET DEPTH OF FLOODING. REQUIRES ESTIMATION OF WEIR SHAPE OF THE ROADWAY; MUST ESTIMATE EFFECTIVE FLOW LIMIT ON RIGHT (SOUTHEAST) ROADWAY OF RT. 110 AS IT SLOPES CONTINUOUSLY DOWNHILL TO CITY OF ISERLIN. AN ESTIMATE OF 0.01 SLOPE FOR THE RIGHT ROADWAY WILL SUFFICE FOR ESTIMATING WEIR FLOW; LEFT ROADWAY HAS A 0.04 SLOPE.

CALCULATE WEIR FLOW; ASSUME WEIR C = 2.6, AND TRY DIFFERENT FLOOD DEPTHS TO GET RATING CURVE

USE STANDARD WEIR EQUATION:

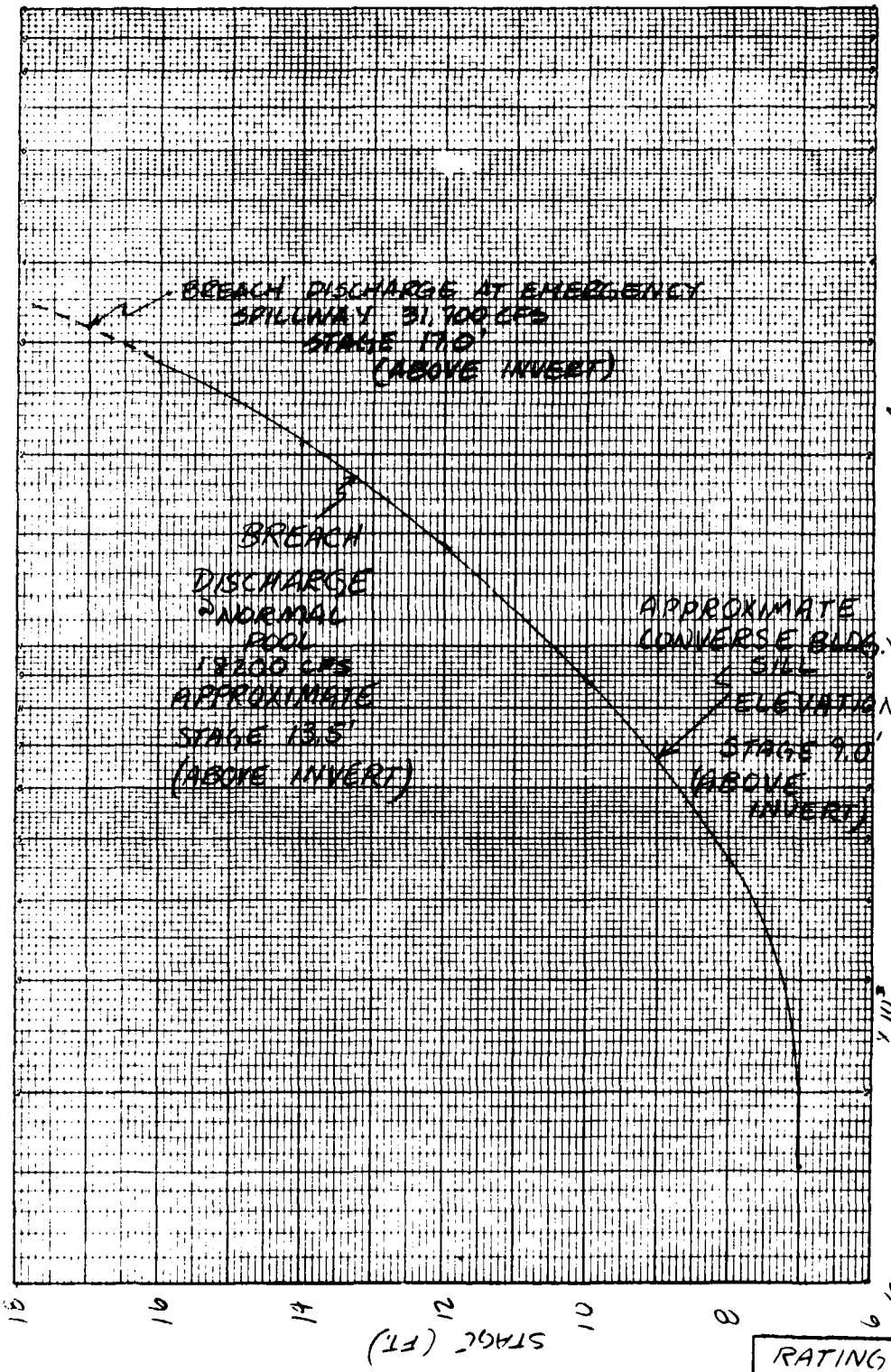
$Q = CLH^{3/2}$

3.15-11

RATING CURVE (DEAD RIVER)

9 OF 18 RH INCS

CROSS-SECTION AT CONVERSE BUILDING



RATING CURVE AT CONVERSE BUILDING

SQUARES 1/4 IN. SCALE

STAGE = 2': $Q = \frac{1.486}{0.04}(15)(1)^{2/3}(0.002)^{1/2} = 25$ CFS

STAGE = 4': $Q = \frac{1.486}{0.04}(245)(1.19)^{2/3}(0.002)^{1/2} = 444$ CFS

STAGE = 6': $Q = \frac{1.486}{0.04}(875)(1.07)^{2/3}(0.002)^{1/2} = 1520$ CFS

STAGE = 8': $Q = \frac{1.486}{0.04}(1705)(2.09)^{2/3}(0.002)^{1/2} = 4631$ CFS

STAGE = 10': $Q = \frac{1.486}{0.04}(2535)(3.11)^{2/3}(0.002)^{1/2} = 8977$ CFS

STAGE = 12': $Q = \frac{1.486}{0.04}(3365)(4.12)^{2/3}(0.002)^{1/2} = 14367$ CFS

STAGE = 14': $Q = \frac{1.486}{0.04}(4195)(5.12)^{2/3}(0.002)^{1/2} = 20705$ CFS

STAGE = 16': $Q = \frac{1.486}{0.04}(5025)(6.12)^{2/3}(0.002)^{1/2} = 27934$ CFS

END

FILMED

8-85

DTIC